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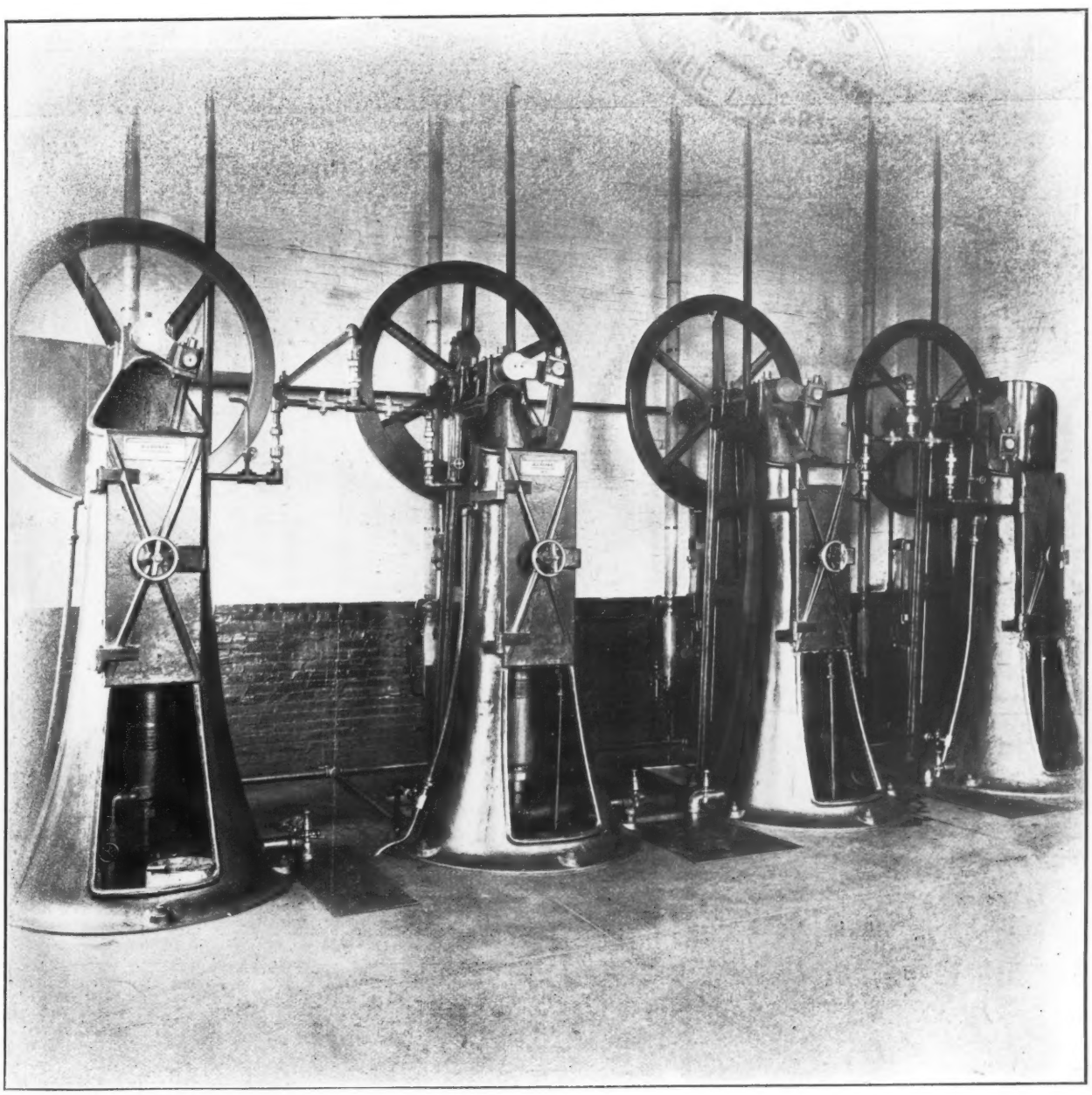

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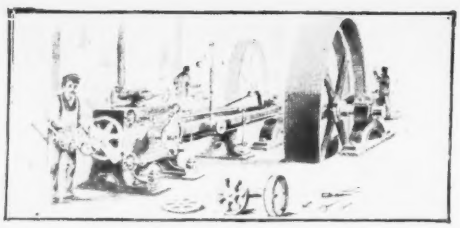

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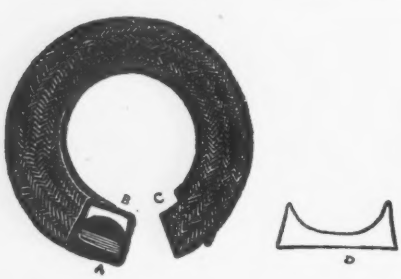

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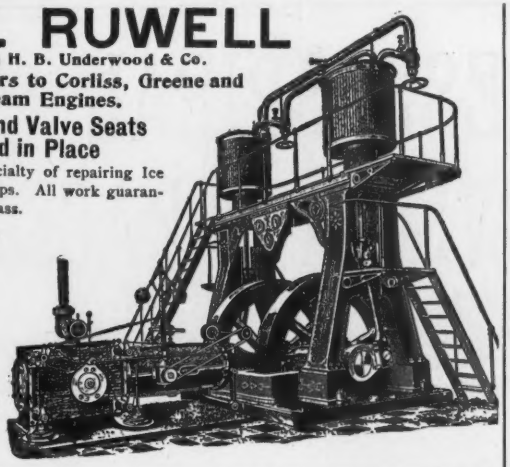

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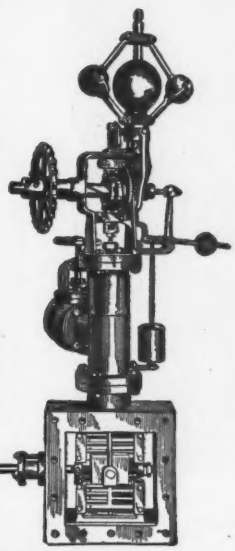

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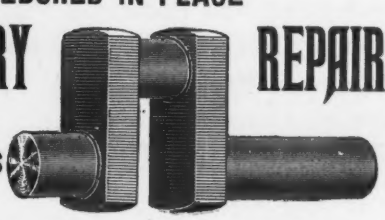

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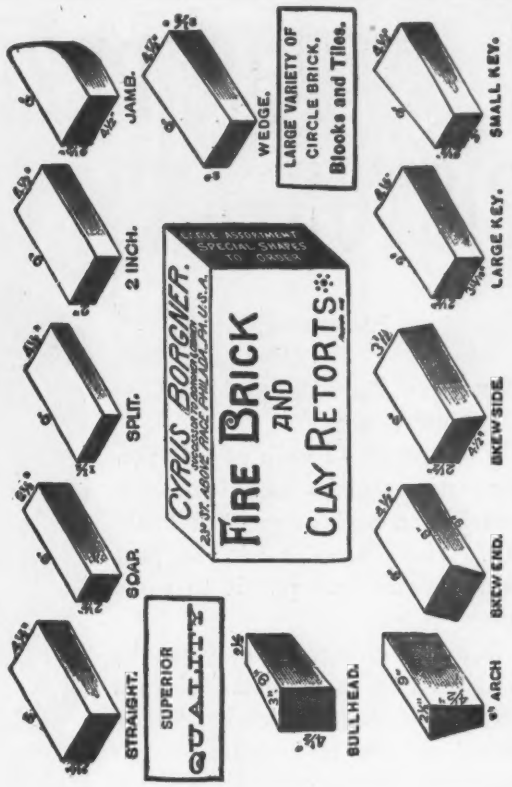

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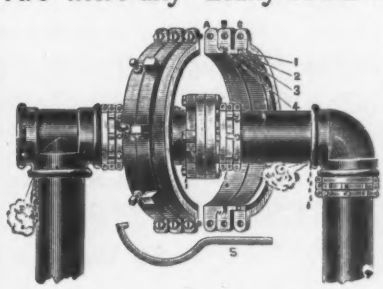

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THE PEERLESS RUBBER MFG. CO.,
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While in charge of the Escanaba & Gladstone Transportation Co.'s Steamer "Lotus," which has a compound engine and steam at 140 lbs., we ran 22,000 miles on a single packing.

Congratulating you on the success of the same, and assuring you that I shall always recommend it when I possibly can, I remain,

Yours truly,
ALFRED LARSON,
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Celebrated "Rainbow Packing," "Peerless Piston and Valve Rod Packing," "Eclipse Sectional Rainbow Gasket," "Hercules Combination," "Honest John," "Zero," "Success," "Arctic" and "Germane Packings."

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The Practical Engineer

THE
OFFICIAL ORGAN
OF THE
AMERICAN ORDER
OF STEAM ENGINEERS

Devoted to the Interests of Stationary Engineers.

VOL. VI. PHILADELPHIA, NOVEMBER, 1902 No. 10

Conditions Governing the Selection of an Engine

What type of engine shall we purchase—a high or a low speed, an automatic or a slide valve? This is a question which is certainly confusing to the judgment, and the subject permits such wide and varied arguments in favor of each device and design, that one scarcely knows how to make a proper selection.

In reply to such a question we are usually met with the statement, "When you are ready to buy, select the best engine, for in the long run the best is cheapest." Now that is such a universal rule that it is seldom disputed. But, there are circumstances which may modify such a rule considerably. For instance, there are places where the price of fuel is so low as to scarcely warrant paying a high price on an engine to save it. In such localities one may safely select a common slide valve engine with a throttling governor, and this for several reasons, among which are low first cost, simpleness of detail, and ease of repair by most any one familiar with engines at all.

This, of course, is only true up to a certain size—say engines having cylinders of eight inches diameter or less. It can easily be shown that the slide valve type of engine is not economical; but, there are other things to be considered, for where small power is all that is wanted, it is desirable that the investment be as low as is consistent with commercial success.

If, however, it be thought advisable to use one of the many types of automatic cut-off engines, the question will arise—which one? For sizes, say from 8 to 24 inches of cylinder, it will be well perhaps to use an automatic slide cut-off.

Again we have the question of speed; the general tendency seems to be in the direction of a horizontal engine having a short stroke, a rapid speed piston and a rapid rotation of crank shaft. There is a decided economy in this, as a small engine running at quick speed will be quite as efficient as a large engine running at a low speed, with the advantage that the former will not cost, in original outlay, more than a little over one-half the price of the latter, with the cost of operation about the same per indicated horse-power.

In a general summing up of conditions we find the best automatic engines (non-condensing) furnish an indicated horse-power for about three pounds of good coal, depending somewhat upon the fitness of the engine for the work and the quality of the coal. With a condenser attached, a consumption as low as two pounds has been reported, but this is an exceptional result, 2½ pounds may be quoted as good practice. The larger the engine the better the showing, as compared with smaller engines.

For ordinary slide valve engines, the coal burned per indicated horse-power will vary from 9 to 12 lbs., for the sake of illustration we will say 10 lbs., and that the engine is of such size as would require for a year's run $3,000 worth of coal; now, an ordinary adjustable cut-off engine with throttling governor, ought to save at least half that amount of coal, or say $1,500 per year; if the best automatic engine were employed using 2½ lbs. of coal per horse-power, a further saving of $750 per year could be effected, or between the two extremes, $2,250 per year in saving of coal, without interfering in any way with the power, with the exception, perhaps, that the automatic engine will furnish a better power than the former engine. It is easy to see that it is true economy to buy the best engine and pay the extra cost of construction, if the saving of fuel is an element entering into the question of selection.

The cost of an engine for any particular service is always to be taken into consideration, for it is possible to contract for a certain saving of coal at too high a price, not simply when paid out as the ordinary purchase money, but

with this economy of fuel, the purchaser may have many vexations and damaging delays caused by the breaking of the automatic mechanism of the engine. All such delays which would not have occurred to an ordinary or simpler engine, are to be charged against any saving credited to the engine which failed in producing a regular and constant power. Take a flour mill for example, producing 400 barrels per day; it is easy to see how a single day's stoppage would interfere with the trade and shipment by the proprietors, yet it would require a very small break in an engine that would require less than a day for repairs.

This does not argue against high grade engines, but the purchaser should be certain that the engine, when once on its foundations, shall be as free from dangers of this kind as any other engine of similar economy.

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Philadelphia Engineers' License Law Attacked

At the present time there is considerable agitation in engineering circles in Philadelphia over an attempt being made to break the present license law governing engineers. For a long time it has been apparent to many that there has been little effort made by the manufacturers to comply with the requirements of the law in relation to their engineers.

The Chief of the Steam Boiler Department of the city, John M. Lukens, under whose direction such matters come, has repeatedly warned the transgressors, but seemingly with little effect, he at last determined to make an example of sufficient magnitude as to mark a precedent which would have a restraining influence with others. In accordance with these views he issued warrants for, and arrested, the chief engineer and about eight or ten assistants employed by the Sugar Trust in this city. The arrests, however, has called forth an unlooked for contention, instead of the Sugar Trust calmly discharging their unlicensed men and substituting them with men holding proper qualifications under the law, as any law-abiding citizen would be expected to do, they have adopted the usual "trust" methods of attempting to break any law which does not permit them to do exactly as they please; they will attempt to prove that the present law is a constitutional violation and will contest the validity of the law in the courts. There is no doubt that the progress of the suit will be watched with the greatest interest by all concerned.

The present law has proved a very great benefit to the engineering class in this city and also to the manufacturers and employers as well, hence just what is hoped to be gained by the litigation in this case is problematical; it certainly seems unreasonable to think that anyone would fight against a law acting to the benefit of both parties. However, there may be something below the surface as yet not apparent, so we can but await further developments.

In any case, it will be the duty of the American Order of Steam Engineers, and, in fact of all Philadelphia engineers to use their best endeavors for the preservation of the present law.

Two Ways of Conducting Pipe Covering Tests

During the month of November last, one of the country's most prominent and, ostensibly, reliable engineers conducted a rather exhaustive test of several of the leading brands of pipe coverings at the new power plant of the Manhattan Elevated Railway Company, New York City.

These tests, to all outward appearances, were planned and conducted with the intention of ascertaining the efficiency, both comparatively and absolutely, of pipe coverings as ordinarily manufactured, sold and applied. The inauguration of the affair was attended with considerable eclat; prominent members of the American Society of Mechanical Engineers, and others equally interested in the proper determination of the relative value of the many pipe coverings, were invited to attend.

The main object, so far as the getting of the principal data was concerned, was to properly secure and measure the water formed by condensation of steam in pipe lines, to properly accredit the covering showing the greatest amount of deflected radiation.

The name of the engineer conducting the tests would seem to indicate that the work would have been entirely free from "commercialism" and conducted on a plan of absolute impartiality. The plan adopted for determining the results in this case, however, while very elaborate in preparation, was not a system generally accepted as reliable; and the general distrust of it among engineers, is abundantly justified by further tests made along other lines. These latter tests tend to almost completely reverse the findings of the November tests above mentioned, and the most charitable judgment to pass on the latter, is therefore, that the prominent engineer conducting them, was more familiar with other branches of his profession, than the one here assayed.

There seems to be but little reason to doubt that the figures returned by the engineer conducting the tests were in accordance with his findings, but was, all the material used in making the tests bought in the open market without previous knowledge of any of the manufacturers, which would have enabled them, had they been so inclined, to prepare material specially for the occasion.

There was an evident desire to convey the impression that the tests were made for the Manhattan Company and not at the expense of either, or any, of the competing concerns. That the Manhattan Company placed little reliance upon the tests, however, was demonstrated by their making a new test, at their own expense, by their own engineer, Mr. H. G. Stott.

The appended tables show the results obtained in both cases; the first showing the November findings, the latter showing results obtained by Mr. Stott in his tests. It will be observed that while the output of one concern leads, by far, all the others, in the first table, they are relegated to eighth or ninth place in the latter. A comparison of the methods and detailed results will be interesting and of

value to all in choosing an article for pipe covering purposes. The apparatus used in the November tests was what is known as the condensation test and was pretty thoroughly delineated in the 1902 January edition of The PRACTICAL ENGINEER.

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The method used by Mr. Stott consisted of sections of pipe arranged so that a current of electricity could be sent through them, and in that way raise the temperature to that corresponding to what the steam pressure would show. By means of potential wires on the pipe it is easy to get accurate readings which can be calculated in B. T. U. per square foot radiated. This method is considered more reliable than the condensation test.

Order of Efficiency November Tests

2-Inch Pipe Coverings—80 Pounds Pressure

1. Johns' Asbestocel.
2. New York Air Cell.
3. Carey's Moulded.
4. Johns' Moulded.
5. Gast's Ambler Air Cell.

2-Inch Pipe Coverings—150 Pounds Pressure

1. Johns' Asbesto-Sponge Hair Felt, 3 ply.
2. Johns' Asbesto-Sponge Hair Felt, 2 ply.
3. Asbesto-Sponge Felted (Sectional).
4. K. & M. Magnesia (85 per cent. carb. of magnesia).
5. Asbesto-Fire Felt (Navy Brand).

10-Inch Pipe Coverings—150 Pounds Pressure

1. Johns' Asbesto-Sponge Felted.
2. K. & M. Magnesia (85 per cent. carb. of magnesia).
3. Asbesto-Fire Felt (Navy brand).
4. Watson's Imperial.

ELECTRICAL TEST OF STEAM PIPE COVERINGS

Name of Company.	Covering.	Aver. Thick Inch	B. T. U. Loss Per Sq. Ft. at 160 lbs. Pr.
Robt. A. Keasbey	85 per cent. Magnesia: Sectional	2.24	1.623
Nonpareil Cork Mfg. Co.	Solid Cork: "	1.68	1 672
James Quinlan	85 per cent, Magnesia: "	1 18	2.608
Nonpareil Cork Mfg. Co.	Solid Cork: "	1.26	2.048
Robt. A. Keasbey	85 per cent. Magnesia: "	1.19	2.130
Nonpareil Cork Mfg. Co.	Laminated Asbesto Cork: "	1.43	2.123
Philip Carey Mfg. Co.	85 per cent. Megnesia: "	1.12	2.190
H. F. Watson Co.	Asbestos Air Cell (Indent): "	1.26	2.333
H. W. Johns-Manville Co.	Asbestos Sponge Felted: "	1.24	2.556
F. J. Gast	Asbestos Air Cell (Long): "	1.70	2.750
H. W. Johns-Manville Co.	"Asbestocel" (Radical): "	1.22	2.801
New York Asbestos Mfg. Co.	Asbestos Air Cell (Long) "	1.20	2.812
Philip Carey Mfg. Co.	"Standard" Magnesia: "	1.12	.....
Jacob Racich	"Magnesian": "	1.23	.....
Emil Frank	"Remanit" (Silk) Wrapped	1.51	1.452

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"Knocking"—Causes and Remedies

How many times have we stepped into an engine room to be saluted with a series of sounds not unlike those issuing from a blacksmith shop, caused by the "knocking" of the engine or engines, and how many times have we had the chief engineer come up to us with an apologetic air and say, "That infernal engine started to thump awhile ago, I'll have to tighten it up to-night," yet if we call again in a week we will probably find the same old knock there. Now it is not always an easy thing to stop a knock, nor yet is it any easier to detect the exact location of the trouble; hence we must not be too quick in passing judgment just because of a knock. It may be that the knock has caused the engineer considerable thought and work already.

There are several causes which together, or singly tend to produce this very annoying feature in steam engines. In the first place the knocking may be caused by defects in the construction of the engine; such, for example, as not being in perfect line, the crank pin not at the proper angle to the crank, the shaft may be out of line. Such a defect the engineer may have lots of work and worry in locating, but when it is located there is but one remedy, and that is the replacing of that part or the reassembling of the whole machine until a perfect alignment is had in all the parts. All improperly fitting parts, however, should be replaced at once with new ones as a safeguard against accident, which will sooner or later overtake badly fitting pieces.

Engines which have been in use for some time are likely to have a knock caused by the piston just touching the head at either end of the stroke. This is brought about by having a very small clearance in the cylinder and in not having provided, by suitable liners, for the wear of the connecting rod brasses. In such cases, lines should be inserted behind the brasses in the connecting rod, or new brasses put in, which will, of course, restore the piston to its original position. In most cases the trouble will be found in the connecting rod brasses; but whether in the crank-pin end or at the cross-head end is not so easily determined in all cases. A very slight motion will suffice to start a very disagreeable sound, which will increase in volume until the source of the trouble is found and the defect rectified.

The remedy is, in most cases, very simple, and consists in simply tightening the brasses by means of the key or other device that may have been provided for such adjustment. In adjusting a key it is the common practice to drive it down as far as it will go, marking the upper end of the strap, then drive the key loose again; after which redrive it down until the line scratched is within ¼ or ⅛ inch of the top of the strap.

The size of the strap joint and the judgment of the person in charge must decide the best distance in such a case. This may be done at either or both ends of the connecting rod. After such changes have been made, on starting the engine, the cross-head and crank-pin must be carefully watched, and upon the slightest indication of heating, the engine should be stopped and the key eased up a trifle. However, a slight warmth may be looked for at first, which will shortly, as a general thing, correct itself after a short run.

Knocking is sometimes occasioned by a misfit, either in the piston, or cross-head and the piston-rod. These connections should be carefully examined, and, under no circumstances should lost motion be permitted at either end of the piston rod.

If the means of securing are such that the person in charge can properly fasten the piston to the rod, he should see that it is kept tight; if not, then it should be sent to the repair shop at once, as there is no telling when an accident is likely to overtake an engine with a loose piston.

The connection between the piston-rod and cross-head is usually fitted with a key and furnishes a ready means of tightening the joint, if proper allowance has been made for the draft of the key. In case there has not, the piston-rod and cross-head should be filled out so that the draft of the key will insure a good tight joint when driven down.

The main bearing should be examined and if there should be too much lateral movement of the shaft, the side boxes might then be adjusted until the shaft turns freely, but has no motion other than a rotary one. The cap to the main bearing should also be carefully examined, as it may need screwing down and thus prevent an upward movement of the shaft at each stroke; this applies more particularly to quick running engines.

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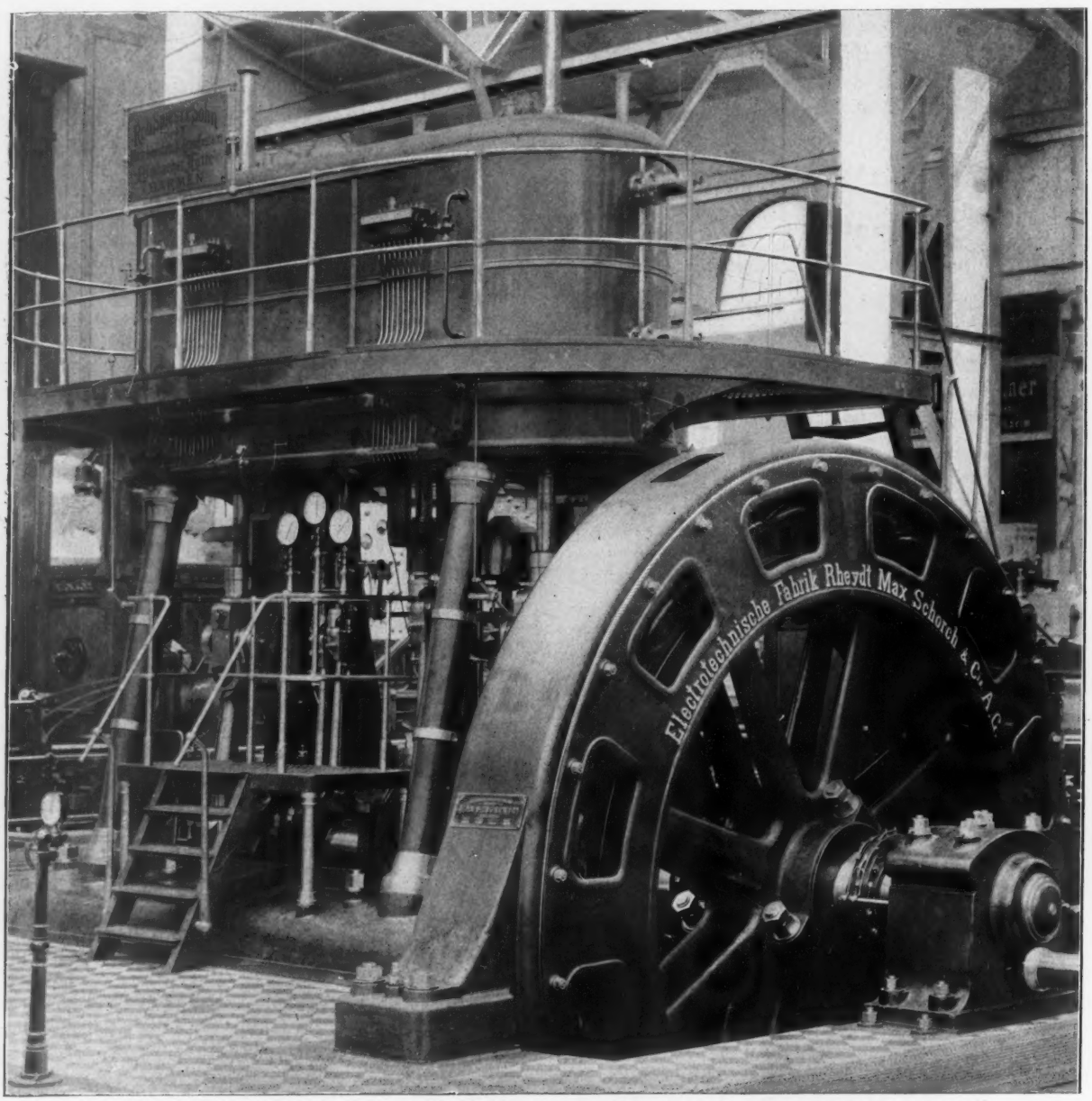
What Foreign Manufacturers are Doing—The Düsseldorf Exposition

Appreciative of American methods of successful exploiting of their mechanical products, The Industrial and Trades Exposition is now being held in Düsseldorf, Germany. The exposition was primarily planned to show the commercial possibilities of Rhenish Prussia and Westphalia, but its great success is a tribute to German enterprise and growth of trade, and shows at once the progress in mechanical arts throughout Germany. The exhibition grounds are situated on the north banks of the historic Rhine in close touch with the city of Düsseldorf. The topography of the surroundings and the natural beauty of the place, combined with mechanical ingenuity in the general construction, has greatly enchanced the value of the exposition.

A glance at the accompanying illustrations will give a good idea of the methods of engine and electrical unit construction in Germany at the present time. Figure one shows the exhibit of one of the foremost electrical concerns in that country —the firm is known as the Rheydt Electro-technical Works, Max Schorch & Company. The electrical generator shown



5000-VOLT SCHORCH THREE-PHASE GENERATOR DIRECT COUPLED TO A SPIES VERTICAL COMPOUND ENGINE.

is a 5000 volt three phase alternator direct-connected to a vertical compound engine, built by the firm of Robt. Spies Fr. Sohn, of Barmen-Leimbach. This unit operates at 142 r. p.

m., and supplies three-phase currents at 5000 volts, the current per phase being 40 amperes and the total capacity 350 kilowatts. The total diameter of the generator is 3872 millimeters. There are 252 slots in the armature core, two per pole per phase, and the dimensions of each slot are 17½ mm. x 30 mm. (.69 x 1.18 ins.) Each slot contains ten conductors four mm. (.1575 in.) in diameter, placed in micanite tubes with walls four mm. thick. The resistance per phase is 0.82 ohm cold and 0.935 ohm warm; the winding is connected up star or Y fashion.

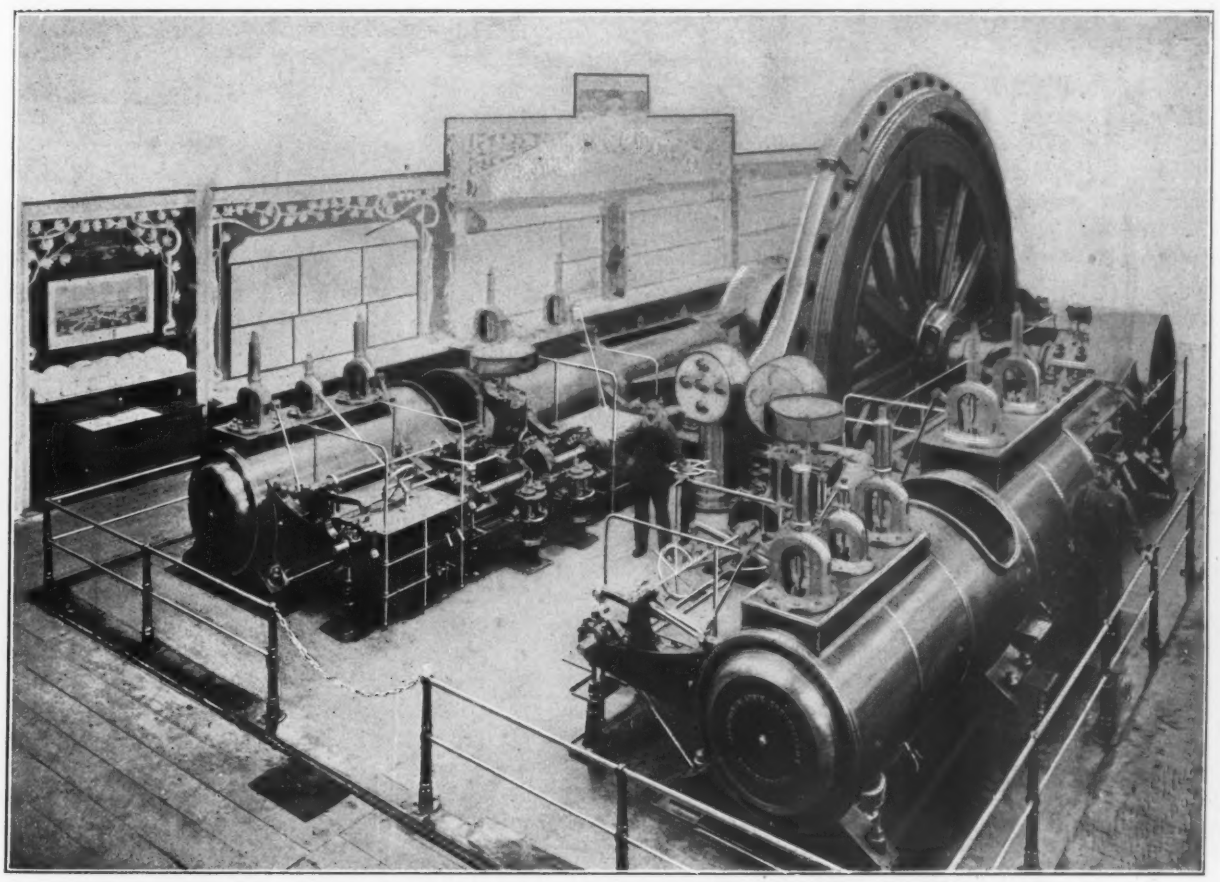
The field magnet ring of this machine is 3500 mm. (11½ feet) in outside diameter and has 42 poles of Siemens-Martin steel, with pole-shoes 250 mm. (9.84 ins.) wide. The field winding consists of 85 turns of rectangular conductor, 5 x 6 mm. (.197 x 236 in.), and the resistance of the winding is 1.5 ohms cold and 1.7 ohms warm, the coils being all connected in series.

Among the other important exhibits of the Rheydt Electrotechnical Works are direct-current and alternating-current motors for both stationary and portable work. One of the most interesting of the latter was mounted on wheels and arranged with its switches, starting resistance and a reel carrying the necessary cable mounted on the top of the machine.

An electrically operated pump for use at great depths is of more than passing interest. It was constructed by the same firm, and is designed to raise 4.5 cubic meters of water per minute a height of 60 meters, the motor running at 1600 r. p. m. The pump is used for supplying water for the fountains from the river Rhine.

The generators above mentioned supply current for 5000 incandescent lamps in Industrial Hall, and also for three large exhibit pavilions. For supplying current to the various direct-current motors, a 200 kw. direct-current Schorch dynamo is used, direct connected to a horizontal compound engine built by O. Recke, of Rheydt.

The engine is a tandem compound, and drives the dynamo at a speed of 140 r. p. m. The dynamo is a 14-pole 500-volt machine, with an armature 2150 mm. (84.65 ins.) in diameter and 410 mm. (16.14 ins.) wide. The field magnet winding consists of 930 turns of copper wire 2.3 mm. (.0905 in.) in diameter, and the complete winding has a resistance of 77 ohms cold and 87 ohms hot.



2000-H. P. TWIN TANDEM COMPOUND ENGINE COUPLED DIRECT TO A HELIOS POLYPHASE ALTERNATOR.

The armature core has 275 slots, each 10½ mm. x 27 mm., and containing four conductors 3 x 7 mm. (.118 x .275 in.) each. The resistance of the armature winding is .018 ohm cold and 0.0205 ohm hot. The air-gap is 7 mm. (.2756 in.) and the bore of the field pole-faces is 2164 mm. (85.2 ins.) in diameter.

Among the polyphase apparatus exhibited by this firm may be noted also seven transformers varying from 20 to 30 kilowatts each, and designed for reducing the 5000-volt three-phase currents of the large generator to 110 volts for lighting and motor work. There are 46 direct-current motors exhibited and 9 polyphase motors, ranging in capacity from ½ to 100 horse-power each.

One of the most interesting exhibits is a large vertical triple-expansion steam engine of 3000 horse-power, direct connected to an alternating current generator and a direct current exciter, the latter dynamo being mounted at the end of the engine shaft outside of the main alternator bearings. This engine was built for the central station at Essen. The diameter of the high-pressure cylinder is 830 millimeters (32.67 ins.) and the low-pressure cylinder is 2050 millimeters (80.7 ins.), while the intermediate cylinder measures 1400 millimeters (55.12 ins.) in diameter; the length of stroke is 1200 millimeters (47.24 ins.) The speed of the engine is 94 r. p. m. and the low-pressure cylinder is equipped with cylindrical valve gear, while the high-pressure and intermediate cylinders are provided with Gutermuth's distributing valve motion.

Among the larger engines shown in Machinery Hall is one of 2000 horse-power, built by the Grevenbroich Machine Works of Grevenbroich (Rheinland.) This engine is of the twin tandem compound horizontal type, and has on each side of a high-pressure cylinder 725 mm. (28½ ins.) in diameter and a low-pressure cylinder 1100 mm. (43.3 ins.) in diameter; the stroke common to both is 1300 mm. (51.2 ins.) This engine runs at 72 r. p. m., and is direct-coupled to a three-phase alternating-current generator built by the Helios Electric Company, of Ehrenfeld, near Cologne, Germany, which supplied a large proportion of the necessary electric current for the exhibition.

The engine develops 2000 effective horse-power when worked condensing with the cut-off at quarter stroke and with steam pressure of 150 lbs. per sq. in. in the high-pressure steam chests. Siemens-Martin steel is used in the construction of the crank-shaft, and it is bored throughout its entire length; the wrought-iron cranks are shrunk on. The large main pedestals which carry the crank-shaft are cast in one piece with the Corliss frames, and the frames have tubular guides carried by the foundation throughout their length. There are four parts to the steps of the main bearing and the crank and cross-head pins are in two parts. All the bearings are adjustable, and the main and crank-pin boxes are lined with white metal. The cross-head pin bearings are of bronze and the crank-pins are of nickel steel. The cross-head pins are of crucible steel, and the cross-heads are of polished cast-steel and provided with long cast-iron shoes. The piston rods are of Siemens-Martin steel, and are all of the same diameter—160 mm. (6.3 ins.) The pistons are hollow and are built so as to support their own weight. They are secured to the rods by means of cones and nuts, and are made of cast-iron. Metallic packing is used on the piston rods.

The oil distribution and devices for catching the waste oil are so arranged that all the lubricating apparatus for moving parts are fixed and may be attended to and replenished at any time while the engine is in motion, as is common practice. Sight-feed drop lubrication is used for all parts not subjected to steam pressure, and Mollerup's oil pumps are used for lubricating the parts under pressure. For the lubrication of the cross-heads, each pin is provided with an oil cup having a metal wiper. The fixed drop feed lubricator is provided with a socket carrying a fine brush, on which the oil from the lubricator drops, and then as the wiper on the cross-head pin lubricator comes opposite, the oil is wiped off the brush and carried with the cross-head. This will be recognized as the method used some years ago on American high-speed engines. The guide shoes are provided with oil grooves and equipped with scrapers of copper below, and of felt above, by means of which the oil is very efficiently distributed over the curved surface of their path.

Distance pieces ars used to connect the high-pressure to the low-pressure cylinders and the latter are directly connected to the Corliss frames, and the cylinders have steam jackets, the whole being cast in one piece. Direct live steam is used for heating the high-pressure cylinders and receivers, and working steam through the main stop valves of the engine, is used for heating the low-pressure cylinders.

Each side of the engine may be worked independently and the cock-levers and stop-valve are all accessible from one position.

In all four cylinders the steam distribution is effected by means of double-beat valves, four being used on each cylinder. The admission and exhaust valves on the high-pressure cylinders are worked by positively closing valve-gear, while the valves of the low-pressure cylinders are worked by cams which are adjustable. Bevel gears are used for driving the valve motion shafts, and the shafts are provided with expansion couplings in order to allow for the longitudinal expansion of the steam cylinders. Above the main pedestal cover there is an oil reservoir from which the oil passes into the bearing proper by means of tubes with an adjustable visible drop feed. The steps of the bearing, as well as the shaft journal, have appropriate oil paths formed in them to insure a proper circulation of the oil, while the oil which flows away from the pedestal is caught in receptacles provided with fine sieves in order to keep out the dust. The oil is pumped from these receptacles back into the oil reservoirs by small oil pumps driven by chain wheels from the valve-motion shafts. The reservoirs are furnished with fine sieves and diaphragms of felt to catch the impurities, and in order that the thick deposits on the bottom may not be allowed to enter the pedestal, the oil is not taken from the deepest point. This arrangement of oil circulation provides very lavish lubrication.

The Grevenbroich Machine Works also exhibits in the main steam generating station of the Exposition an interesting type of water-purifying apparatus. It has a duty of 4444 imperial gallons per hour, which is sufficient for half of the boilers exhibited. The water used for purification is taken from the hot well of the condensing plant (injection condensers.) The apparatus is constructed in the form of a press, and is horizontal, containing in itself the heater, filter and precipitating apparatus, the three parts being mounted together in one frame in such a manner that a number of heater elements in the form of plates, each having a special inlet for steam and for water, are arranged in sequence adjoining the fixed head. The precipitation tank is next, and the filter elements join directly on to this. These contain a channel through which the filtered water is conducted back through the precipitation chamber and the heater elements to the fixed head again.

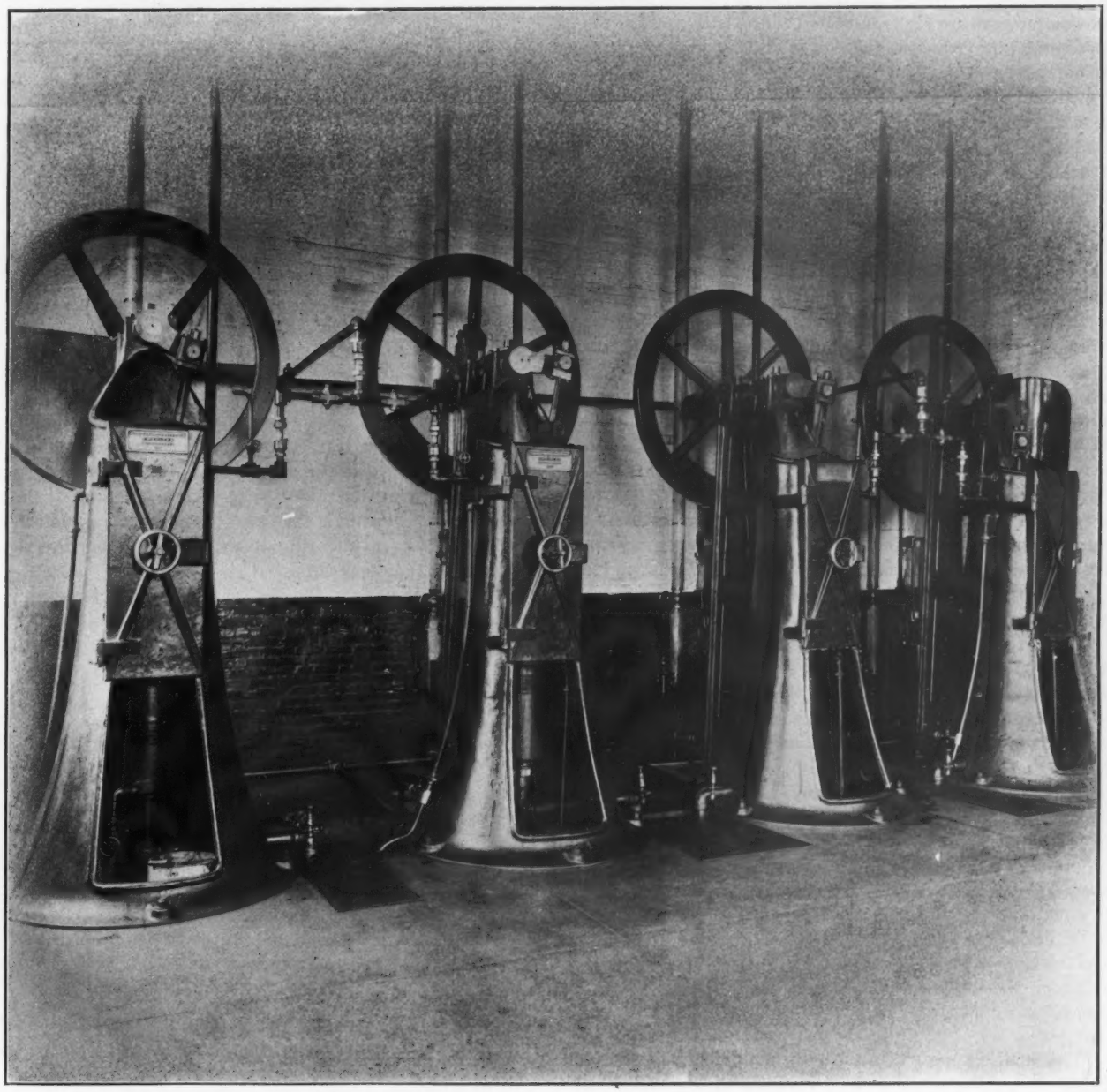
In the operation of this apparatus an independent vertical compound steam pump takes the water to be purified from a collecting tank and forces it through the purifier, delivering it first into the heater, whence it passes into the precipitation tank above, where lye is added to it in a definite proportion, according to the quantity and quality of the water. The water, along with the precipitated matter, then passes out from the precipitation chamber into the adjoining filter chamber, whence it is led into a reservoir from which the feed pumps take water for the boilers. The water is heated by either exhaust or live steam, according to circumstances.

How Illuminating Gas is Provided for Railway Cars

How many of the traveling public who enjoy the gas-light upon railway trains, as they rush from place to place, ever give a thought to the methods placing such a luxury within their reach. Many times we see the attendant come into the car and reach up, turn on the gas, light it with the same results that may be had from direct connection to any gas manufacturing plant, yet we know that there must be some different means provided for supplying the burners, than that used ordinarily, because of the fact of the car being in constant transit. How is it done? This question is often asked and seldom answered; hence there is a not inconsiderable curiosity to learn of the methods employed.

In order to thoroughly delineate the subject, the following description is published: The half-tone cut appearing upon the front cover of this issue of The PRACTICAL ENGINEER shows four direct connected compressors of the J. M. Foster pattern, used by the Pennsylvania Railroad for charging their cars on their eastern lines, with gas for lighting purposes.

The frames, as will be noticed, are of the upright type firmly bolted to a cast-iron base. The engine is coupled directly to the compressor piston, and is of the ordinary slide valve type with a throttling governor—the steam cylinder



GAS COMPRESSORS FOR CHARGING STORAGE TANKS FOR RAILWAY COACHES AT PENNSYLVANIA R. R. CAR SHOPS, PHILADELPHIA.

is 7½" by 18"; the maximum speed is 75 revolutions per minute.

The gas compressing cylinders are of the water jacketed design; the vertical lift valves are made light in weight and the intake pipe large and unobstructed so that there will be the least possible throttling of the gas. Another strong feature is that the valve is so arranged that should it become broken,

the pieces cannot fall through into the cylinder and wreck the machine. The primary object of making this type of compressor vertical is to prevent the valves wearing down out of line with their seats—a common fault with horizontal machines. On account of the intense heat created by compressing the gas the cylinders are completely water jacketed, not only around the barrels, but also around the heads. Through this jacket there is a continual flow of water from a one-inch supply pipe at city pressure.

The method of storing gas in the cars is very simple indeed; the compressors are each connected to the city gas main by a three-inch pipe, which is the size of the compression chamber in diameter. The stroke is eighteen inches. The gas is drawn into the compressor with the up stroke—they being vertical—then upon the down-stroke the charge is let through the piston by means of a check-valve, which closes with the return stroke when the compression takes place, and the gas is driven off through a ¾" pipe into a receiving chamber, 14 feet by 4 feet, maintaining a pressure of 300 pounds per sq. inch. Each compressor is capable of handling in this way 125,000 cubic feet of gas every twenty-four hours, making a total for the four machines of one-half a million feet of gas every day. There are ten of the large tanks, which are arranged with equalizers so that the volume always remains at, or nearly, the same pressure while charging a car. The charging is done by connecting, by means of a hose, the storage tanks to two tanks 10" by 16" which are attached to the cars—the tanks can be seen about midway of the cars, upon either side, at any time. These tanks are charged with a pressure of 160 pounds per square inch and contain when so charged seventy-five cubic feet of gas. This amount will light a car for twelve hours—both tanks guaranteeing illuminant for twenty-four hours steady light. In order to insure against possibility of taking out the cars without a proper supply of gas to last out the intended run, the cars are provided with gauges which correctly register the pounds pressure on the tanks and also the amount of gas contained therein at all times.

The plant is situated in the direct centre of the immense car yards of the Company at 33d and Market Streets, Philadelphia. There is a battery of four boilers of the locomotive type, built at the Company's shops, Altoona, Pa., especially for their present use, which is to supply steam to work the compressors, pumps, etc., and also to thoroughly heat all cars for immediate use before they are run into the station for passengers to occupy them.

* * *

Notes from the Dynamo Room

By Chas. W. Leng

[This article appeared in the 1897 September edition of The Practical Engineer, and is republished in answer to a question appearing under head of "Questions and Answers" in this number.]

A very handy little instrument to have around the dynamo room is an ordinary pocket compass. By means of it many interesting and instructive experiments can be made; but it is well to note here that in any instrument in which a magnetic needle is used, when kept in the vicinity of a dynamo or motor which is in operation, the needle should be allowed to swing freely on its pivot and not be held up by the "stop"; otherwise, the needle is likely to be de-magnetized or have its polarity reversed.

With a compass you can determine the direction of the flow of current in a wire, thus enabling you to locate the + and— sides or ends of a circuit without tracing back, and a simple rule and one that is readily remembered is: If the current flows from south (S) to north (N) over (O) the compass, the needle will point west (W); you will notice that the first letters of each of the principle words spells snow—thus, South,

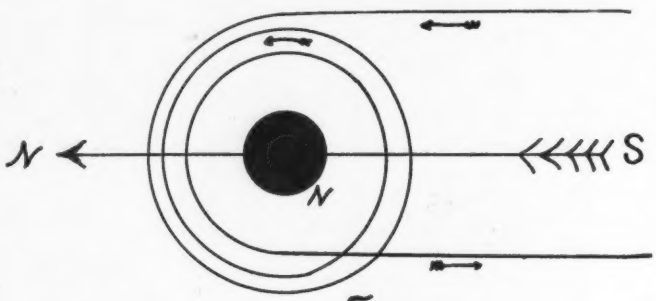


Fig. 1.

North, Over, West. Another simple rule is to allow the needle to assume its natural position, and, placing a wire through which a current is passing over and parallel with the needle, hold your right hand, palm down, with thumb and index fingers extended at right angles, the index finger pointing in the same direction as the wire and need'e; if the current is flowing through the wire in the direction indicated by the index finger, the thumb will indicate the direction in which the needle will turn.

This is evident from the fact, as stated in the foregoing rule, that, if the index finger points to the north and the current flows in that direction over the needle, the thumb will point west and the needle will turn that way.

It is also evident, in connection with this fact, that, if the same wire be brought back under the needle, thus forming a coil, that it will have the same effect, but will act with increased force.

Fig. 2.

This brings up another important fact: that, if such a coil were placed in a north and south direction and the current passed through it from south to north through the top of the coil, and consequently from north to south through the bottom, if you stood on the west side of the coil and facing it, the north seeking end of the needle would be toward you. Now, if instead of a magnetized needle, we place a piece of soft iron (or core) through this coil and allow the current to flow in the same direction as before, it will magnetize the core, and in such a manner that its north pole will be facing you, as shown in Fig. 1; or in other words, it would occupy the same position as the north seeking pole of the needle.

It will be readily seen from this that, when looking at the end of any electro-magnet, the current through the coils of

which flows in the direction indicated by the arrows in Fig. 1, this end will be the north pole.

With the aid of a suitable coil of wire and a few cells of battery, the compass can be made to serve as a galvanometer, and can be used as such in many little tests around the machines and circuits, which we will discuss at some future time.

Speaking of simple rules, there is another, known as "Fleming's Hand Rule," which determines the direction in which a current will flow in a wire which is moving through a magnetic field in such a manner as to cut the lines of force in this field; as, for instance, the conductors or wires on an armature of a dynamo when passing the field magnet poles. Fig. 2 shows the position of the right hand, in which the thumb and index finger are extended at right angles to each other, and the middle finger is bent over at right angles with

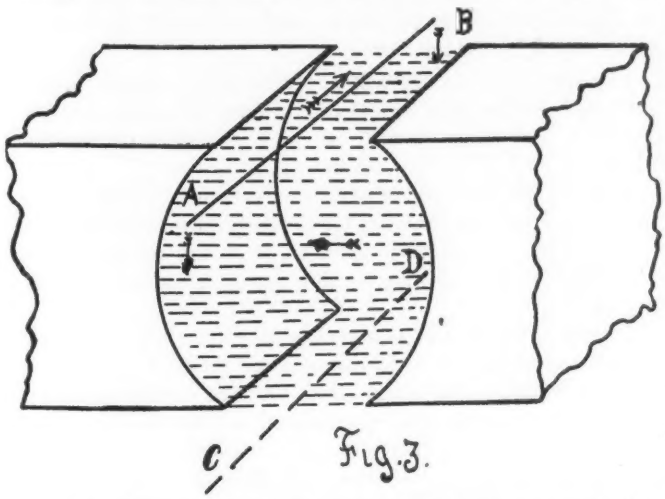


Fig. 3.

the index finger. Here the thumb indicates the direction in which the conductor is used; the index finger indicates the direction of the line of force, and the middle finger the direction of the resultant current induced in the conductor.

This is illustrated in Fig. 3, in which the light dotted lines represent the lines of force, their direction being as shown by the arrow; the line A B is the conductor, which is being moved vertically downward to the position C D, cutting across the lines of force. Now, if the hand be placed so that the index finger points in the direction in which the conductor A B is moving, the middle finger will indicate that the current will flow from H to B, as shown by the arrow.

It will be readily seen that, if the conductor be moved back as in from C D to A B, and the hand turned so that the thumb coincides with this motion, the induced current will flow in the opposite direction, being so indicated by the middle finger.

These simple rules are very easily memorized, and will often save many an hour's work, which, though it may not be laborious, might be more profitably spent.

* * *

Do you attempt to stop pounding in your engine by laying for the crank-pin when it comes around, and trying to hit the key once in awhile?

If you do, ask the strap and neck of the connecting rod if it likes the treatment when you don't hit the key and do hit the oil-cup?

The Conditions Under Which Water Seeks Its Level

By T. H. Reardon

One of the most common statements made in every day life is that water always seeks its level.

That this statement is practically correct in the majority of cases the writer will not attempt to dispute; but there are a great many exceptions to this old time-honored rule, and it is the purpose of the present article to point out a few particular instances in which water may rise higher than the level of its source, and again other instances where it fails to reach its own level. The statement that water will rise to the level of its source is more nearly true in a hydrostatic system where no flow is taking place, than it is in a hydraulic system where friction in the pipes tends to prevent the realization of ideal conditions.

In a hydrostatic system when an exception to the foregoing statement is observed, it can generally be referred to a difference in temperature between the columns of water that are supposed to balance each other. In a water supply system when the source and the outdoor portion of the system is at a temperature of 40° or even lower as in winter time, and the temperature indoors is at about 70°, in the case of buildings 60 or 70 feet high, it will be readily apparent that the water can reach a point higher than the outdoor level.

The gauge glass in the water column of a steam boiler affords another instance of the same kind, except that in this case the water level in the glass will be lower than the water level in the boiler, as the conditions are reversed, the water in the glass is cooler and consequently more dense than the water in the boiler, and if the water column is removed any distance from the boiler as it is sometimes for convenience, this difference will be more marked.

The most striking exception to water seeking its level is observed in instances of capillary attraction, if a piece of a thermometer tube is broken off at both ends, the mercury blown out and the tube held vertically and its lower end is dipped in water, it will be found that the water will rise in the tube anywhere from 2½ to 4 inches, dependent upon the diameter of the bore of the tube, it is well in making this experiment to add a little ink or coloring matter to the water so that the extremely fine column in the tube can be more easily seen.

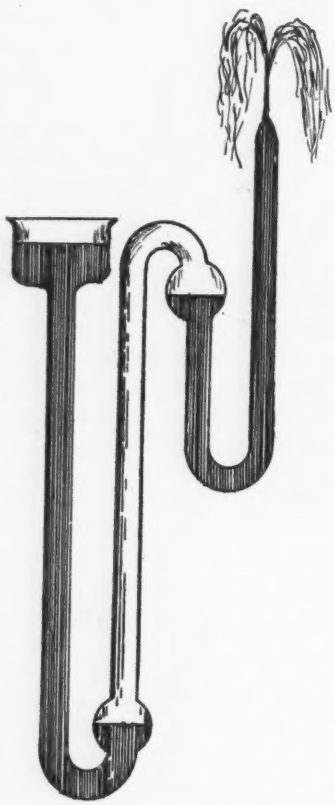
In a steam system where the condensing steam is returned to the boiler by means of a gravity system the water, of course, has the advantage of being cooler and heavier than the water in the boiler against which it has to force its way, but here the pressures on top of the water in the boiler and also on top of the returning column of water must be taken into account, for if the system of piping is of any considerable length, the drop in steam pressure necessary to maintain the circulation will be apparent at the point where the water returns to the boiler, and the returning column of water will have to build up in height until its weight is sufficient to overcome the excess of steam pressure in the boiler over the pressure to which itself is subject.

When two columns of water that have exactly the same density throughout, and that are subject to exactly the same surface pressure are placed in communication with each other, then the level of the two columns will coincide, but under any other conditions coincidence of the two levels will not occur.

In a hydraulic system, when the water is shut off at the reservoir and the system of piping is allowed to become empty, for the purpose of making repairs, in some particular instances, upon admitting the water again it will not flow through and discharge as it did before, this condition is generally due to air that has become trapped in the piping, and, according to the particular place it occupies, it may either retard the flow or accelerate it.

Water pipes laid in the earth are generally laid at a uniform depth, and when the surface of the land is undulating, the pipes of course will be subject to elevation and depression at different points, in their length. If a column of air is trapped under such conditions it will communicate the pressure exerted by the column of water at its end, but being practically without weight itself, it brings about an unbalanced condition, and will cause an additional pressure to exist at some point in the system, while under normal conditions there would be a perfect balance.

If the air occupies a length of the pipe in which the water descends in its flow under normal conditions, the effective head will suffer reduction, but if the air should occupy an ascending portion of the pipe, the effective head of water will be temporarily increased, as the column of air transmits the pressure exerted by a descending column of water, but lacking weight, it does not gravitate backward with much force itself, and so it causes no retardation. Under the last mentioned condition water may rise temporarily very much higher than the level of its source. Hero's fountain, a description of which will be found in the accompanying cut, will afford a very ample demonstration of water rising above its level under such conditions, and if it is desired to construct the apparatus, it can be put together in a few minutes, making the connecting of small rubber tubing, of which about three yards will be sufficient.



HERO'S FOUNTAIN.

As another instance, the writer has seen it stated that the mouth of the Mississippi River is higher than its source, *i. e.*, that it is farther from the center of the earth, allowing that there may be a slight difference in the level, it can easily be referred to the centrifugal force of the earth, so there is no paradox in the matter anyway. In conclusion it may be said that water acts in obedience to gravitation in the same way as all other inert matter, and when its deportment is understood, there is nothing connected with it that cannot be readily reconciled with common natural laws.

Use and Abuse of the Injector

The injector, while being the simplest piece of mechanism with which the engineer has to contend, is also the least understood, as a rule. Many times the failure of an injector is entirely due to the lack of proper knowledge of the device upon the part of the attendant, and not to any fault of it or its construction; hence a word or two upon this very much used and very much abused appliance will no doubt be of interest.

The motive force of the injector is found in the heat received from the steam. The steam is condensed and surrenders its latent heat and some of its sensible heat. The energy so given up by each pound of steam amounts to about 900 thermal units, each of which is equivalent to a mechanical force of 778 foot pounds. This would be sufficient to raise a great many pounds of water against a very great pressure could it be applied, but a large portion of it is used simply to heat the water raised by the injector.

The above explanation will apply to every injector in the market, but ingenuous modifications of the principles of construction have been devised to meet a variety of requirements.

That the condensation of the steam is necessary to complete the process will be evident, for if the steam were not condensed in the combining chamber, it would remain a light body, and, though moving at high speed, would have a low degree of energy.

Certain injectors will not work well when the steam pressure is too high. In order to work at all, the injector must condensate the steam which flows into the combining tube. Therefore, when the steam pressure is too high, and, as a consequence the heat is very great, it is difficult to secure complete condensation; so that for high pressure steam, good results can only be had by using cold water. It would be well when the feed water is too warm to permit the injector to work well, to reduce the pressure, and, consequently the temperature of the steam supplied to the injector, as low temperature steam condenses much easier, and consequently can be used with much better results, throttling the steam supplied by means of stop-valves will often answer in this case. The steam should not be cold or it will not contain heat units enough to be driven to the boiler. This is the reason why exhaust injectors fail to work when the exhaust steam is very cold. It also explains why such injectors work well when a little live steam is admitted to the exhaust chamber sufficient to raise the temperature above 212 degrees.

Leaks affect injectors the same as pumps, and, in addition, the accumulation of lime and other mineral deposits in the jets stops the free flowing of the water. The heat of the steam is the usual cause of the deposits, and, when this is excessive, it would be well to discard the injector and feed with the pump.

The efficient working of the injector depends upon the size of the jet, which should always be left as the manufacturer made it; hence, in making repairs and cleaning, a scraper or file should be used.

For cleaning injectors, where the jets have become scaled, use a solution of one part muriatic acid to from nine to twelve parts of water. Allow the tubes to remain in the acid until the scale is dissolved, or it is soft enough to wash out readily.

The lifting attachment, as applied to any injector, is simply a steam jet pump. It is combined with the injector proper and is operated by a portion of the steam admitted to the instrument. Nearly all the successful injectors on the market are made with these attachments, and will raise about 25 feet, if required, from a well or tank below the boiler level.

When an injector is required to work at different pressures, it must be so constructed that the space between the receiving tube and the combining tube can be varied in size. As a rule this is accomplished by making both combining and receiving tubes conical in form and arranging the combining tube so that it can be moved to or from the receiving tube, and the space thereby enlarged or contracted at will. The adjustment of the space between the two tubes by hand is a matter of some difficulty, however; at least, it takes more time and patience than the average engineer has to devote to it, and the majority of the injectors in use are therefore made automatic in their regulation.

The injector is not an economical device, but it is simple and convenient, it occupies but a small amount of space, is not expensive and is free from severe strains on its durability; moreover, where a number of boilers are used in one establishment, it is very convenient to have the feeding arrangements separate, so that each boiler is a complete generating system in itself and independent of its neighbors.

* * *

Old Friends in New Clothes

By A. Edward Rhodes, Wilmington, Del.

Author of Mechanical Drawing for Self-Instruction

THE INJECTOR

There is an apparent paradox involved in forcing water into a boiler against the pressure of steam by means of only a small jet of the same steam, and yet it is readily seen that this seeming impossibility is really in accordance with natural laws. No one will contradict me when I say that, at least, the fundamental principles involved in the operation of the injector should be thoroughly understood by every one having anything to do with the steam plant.

The operation of the injector does not involve any principle like a perpetual motion, and is not doing work without consumption of power. Mr. Forney, in his book "Catechism of the Locomotive," states the principle in substantially these words: Steam escaping from under pressure has a much higher velocity than water would have under the same pressure and condition. The escaping steam from the receiving tube unites with the feed water in the combining tube, and gives to this water a velocity greater than it would have if escaping directly from the water space in the boiler. The power of this water to enter the boiler comes from its weight moving at the velocity acquired from the steam, and it is thus enabled to overcome the boiler pressure.

He then goes on to illustrate this by the example of a wooden croquet ball, which will float on the surface of the water, but if thrown violently into the water it will sink before its buoyancy will overcome its momentum, while a very light hollow ball will not sink, no matter how much force we may expend in throwing it into the water, because its momentum or actual energy is much less than is that of a solid ball. If steam were not condensed it would not have sufficient energy to overcome the boiler pressure.

Another writer, Sinclear, describes the principle very nicely in the following language:

The principle of the injector's action is that of induced currents. A current of any kind has a tendency to induce a movement in the same direction of any body it passes over or touches. Thus we are all familiar with the fact that a current of air (called wind) passing over the surface of a body of water, sets waves into motion.

In the same way a jet of steam moving very rapidly when injected into a body of water, under favorable conditions, imparts a portion of its motion and starts momentum sufficient to overcome the original pressure of the steam. That is how the injector is made to force water into a boiler against the same pressure the steam is starting from. There are many other

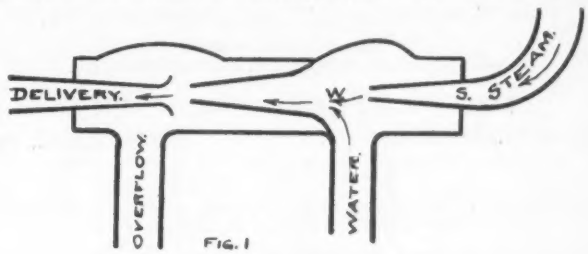


DIAGRAM OF INJECTOR

applications of this principle, the most common of which are: The ordinary locomotive blast, blowers, steam siphon, steam jets, jet exhausters and Argand burners.

Closely examined, its mystery as a source of power disappears; for it is found that an amount of heat equal to the mechanical equivalent of work done is used up during the operation of feeding.

Thus, when a given quantity of heat units pass from the throttle to work the injector, the whole of the heat does not return to the boiler along with the feed water, as was at first supposed to be the case, but a portion of the heat representing the foot pounds of work done is dissipated, besides other losses due to leakage, radiation and convection.

There are many forms of injectors in use, but all of them conform to the above elementary principles in their mode of action.

In figure 1, steam enters from the boiler, passes through the steam pipe and receiving tube S, at a high velocity and, combining with the water at point W, condenses, but imparts considerable momentum to the water which rushes along into the delivery pipe, raises the check-valve and passes into the boiler. As the current of water for starting the injector could not be induced against the constant pressure on the check-valve, which equals the pressure at the throttle, an overflow is provided, when the water can flow unchecked until the necessary momentum is obtained, when the overflow is closed.

* * *

Do you feed the boiler until the water completely fills the gauge-glass, and then shut off the feed, put in a big fire and sit down in a dark room with a four-horse clay pipe and smoke, until you happen to think the water may be getting low?

If you do these things, you had better notify the coroner that he may be called upon at most any time to decide how you died, but it is better to cease the above practice before it becomes necessary to call the coroner.

The Practical Engineer.

PUBLISHED ON THE FIRST OF EACH MONTH

By L. L. RICE, Proprietor, - - - - 1213-15 Filbert Street, Philadelphia, Pa.

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AMERICAN ORDER OF STEAM ENGINEERS
NEWS OF THE COUNCILS

We understand that Southwark Council, of Philadelphia, will give a grand banquet and entertainment some time in the near future.

✣

Lehigh Council No. 15, of Allentown, Pa., is progressing finely taking in new members right along and conducting a line of educational work that is bringing out a good attendance to every meeting. The Councils in our large cities will have to hustle if they want to keep ahead or even abreast of this little up-state town.

✣

We are informed that some of the recent meetings of Sunbury Council have been very interesting and that the attendance is increasing.

✣

Germantown Council, No. 22, Philadelphia, has admitted eight new members since their "Smoker" of Septembe 3d. There is good stuff in Germantown and we will look for similarly encouraging reports with increasing frequency.

✣

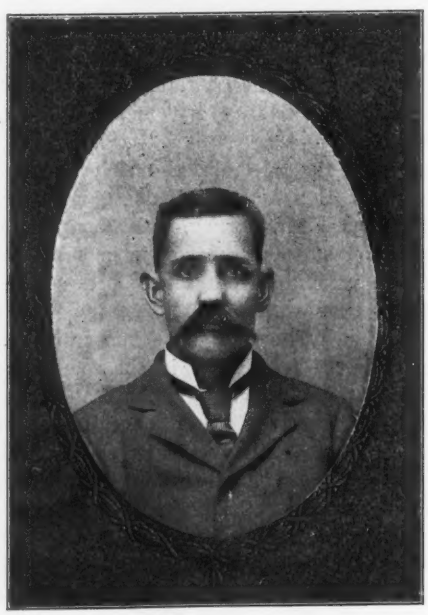
Both Washington Council, No. 1, and Clifford P. Williams Council, No. 2, of Milwaukee, are reported to be making an energetic and successful bid for new members. They are good Councils.

A New Council of the A. O. S. E. at Hartshorn, I. T.

A new Council of the American Order of Steam Engineers, to be known as Black Diamond Council, No. 1, was instituted at Hartshorn, Indian Territory, on Saturday evening, September 20th, by Deputy Supreme Chief Engineer J. W. Eastwood. The new Council started off with only 15 members, but this number has since been nearly doubled, and, as we are informed

C. O. LORENZ.

that the members have taken hold of the work with unusual enthusiasm, the prospects for the Council's future seems bright. Mr. C. O. Lorenz is Chief Engineer, and Mr. John



J. W. EASTWOOD.

Kelley, Corresponding Engineer. The Council meets every Tuesday evening. Mr. Lorenz, whose portrait appears herewith, is Master Mechanic for the McAlister Coal Co., of Hartshorn, and Mr. Eastwood is Chief Electrician for the same Company.

A Pleasant Time at Pittsburg

Iron City Council, No. 21, of Pittsburg, held a smoker for members on Saturday evening, October 4th, and the way the boys turned out was an agreeable surprise to the leaders of the movement. Everybody seemed to be there and in a good humor. There were several interesting talks which were productive of a progressive and harmonious feeling which will do the Council untold good. Some of the boys who have not been attending very regularly said, when leaving, that they never knew the meetings were so interesting, and declared they would not miss any meetings in future. Iron City Council meets every Saturday evening at 1070 Fifth Avenue.

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Open Meeting to be Held at Chester

Delaware County Council, No. 6, of Chester, Pa , will hold an open meeting on Saturday evening, November 1, at their rooms in Carpenter Hall, 6th and Wall Streets, to which all engineers are invited. The Council also hopes to have a number of visiting brothers from Philadelphia and Wilmington.

✣ ✣ ✣

Educational Committee, A. O. S. E.

JOHN MARTIN, Secretary, 2655 East Clearfield St., Phila.

The following questions are intended to create discussion in councils of the American Order of Steam Engineers. Answers will not be required by the Committee but prizes will be awarded by the Committee for the best essays prepared by individual members upon any of the questions asked. The PRACTICAL ENGINEER will give cash prizes for the best essays prepared by engineers whether members of the A. O. S. E. or not.

11. What are the most prominent mechanical appliances used for the prevention of scale?

12. Upon what theory are such devices designed and how are they constructed?

13. Will the use of such mechanical appliances prevent the formation of scale without using chemicals or compounds in conjunction therewith?

14. What is an efficient method of preventing oil getting into the boiler when the condensation from an exhaust steam heating system is returned to the boiler?

15. Is the use of a mud drum of any utility? Why are they not applied to return tubular boilers to a greater extent than is common practice to-day?

16. What is the difference between an open and a closed exhaust steam feed water heater?

17. Under what conditions would either form of such heaters be preferred above the other?

18. Describe the detail construction of various forms of safety valves and explain the theory of the same?

19. What is the reason that the Philadelphia Boiler Inspection Ordinances requires the size of the safety valve to be determined not only with reference to the heating surface, but also with reference to the pressure it is to blow off at?

20. Is it not bad practice to place the gauge cocks upon the same connection to the boiler that the gauge-glass is placed upon? Would it not be better to have each upon a separate connection?

Announcement

To the Instructors of Subordinate Councils:

SIRS AND BROTHERS:—You are hereby informed that hereafter the questions from the Educational Committee will be furnished you through the columns of The PRACTICAL ENGINEER instead of through direct communication as heretofore.

Fraternally,
JOHN MARTIN,
Secretary Educational Committee.

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Work for You

[FIFTH LETTER]

To the Individual Member of the American Order of Steam Engineers:

DEAR SIR AND BROTHER:—In the open letter to you in the October issue of this publication, I sought to impress upon you the necessity and importance of your continual attendance at the meetings of your Council, also the value of such attendance to yourself and to the organization. Now, I wish to go a step further and appeal to you to take an interest in its financial affairs, and lend your assistance, advice and suggestions toward having such business conducted in a manner that will provide for each member the greatest amount of pleasure and profit that can be secured from a systematically conducted organization, wherein a unity of purpose and a harmony of action prevail.

With this end in view I would remind you that our Order is similar to a partnership which extends over a vast amount of territory, and covers a variety of interests that are of value to each individual member of the corporation. Because of this, and the additional fact that you, as one of the partners invest a certain sum per annum to procure for yourself the benefits which are promised you in its declaration of its principles and objects, it is incumbent upon you to devote the same amount of thought and energy toward promoting its financial solidity, that you would do were you a partner in a mercantile or industrial corporation.

I feel safe in asserting that were you a partner in such a corporation, it would not require any great amount of persuasion to induce you to take an active interest in the conduct of its financial features, nor would there be any necessity to point out to you, that it is to your advantage to see that its affairs are so administered as to guarantee the largest possible return upon your investment; neither would there be any need to awaken you to a realization of the fact that your interests in the corporation, as well as your duty to your partners, renders it imperative that you contribute your share of time, thought and energy toward maintaining its financial reputation upon a substantial basis.

By inditing the foregoing, I hope to impress upon you the fact that, the same is true in at least one sense of your relations to our Order, and I trust that it will be the means of leading you to take an active interest in the administration of the financial affairs of the organization, as well as securing your co-operation in furthering its progress and prosperity, for it is as much a necessity to support the structure of our Order by careful, conservative financial means as it is to build it upon a foundation of commendable purposes.

It is to you, if you are one of those members who passively accept the product of the labor of the active members, without making any effort to encourage or assist them, that this letter is particularly directed, by a desire to lead you to see that it is unfair for you to maintain your attitude of indifference and at the same time hope to see the organization grow without your aid to that magnitude which the nature of its purposes indicate it should attain.

While it is true that a certain class of members give their time and attention to the conduct of the affairs of your Council, with a devotion that appears to you to be indifference to your neglect, it is nevertheless true that your inattention has a detrimental effect upon the welfare of the organization, and acts as a barrier to the extention of its usefulness and influence, because your failure to comply with the responsibility imposed by your membership has a tendency to discourage such active members and serves in a great many instances to nullify the result of their labor.

In thus appealing to you, I wish it to be distinctly understood that I have no desire to create a band of cronic kickers and objectors that do more harm than good, neither do I desire to condemn any well directed objection that is put forth in the proper time and place against any movement that may appear to you to be adverse to the best interest of the organization; such objections are always helpful, and show that you are interested in its welfare, but I do disapprove of that tendency to carry a controversy to such a degree as to make it a cronic sore and nuisance.

What I want to secure is, your assistance in conducting the financial affairs of your Council in co-operation with those members who have shown by years of devotion to the administration of such matters, that they consider it to be of paramount importance that its financial affairs should receive the attention of each member, and I do hope that my efforts will not be in vain and sincerely trust that our Order will soon experience a great impetus as the product of your efforts.

In the systematic conduct of the financial business of your Council there is *Work for You.*

Fraternally yours,
CLIFFORD P. WILLIAMS,
Supreme Chief Engineer A. O. S. E.

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Books and Publications

MODERN ENGINEERING PRACTICE Containing Ten Volumes of Material of Interesting and Instructive Value to Engineers

The American School of Correspondence at the Armour Institute of Technology, Chicago, has recently issued one of the most elaborate reference libraries analogous to the engineering profession we have yet seen. The library consists of ten 6½ by 9⅝ inch volumes aggregating 4000 pages, with suitable illustrations in profusion. The books are handsomely bound in half morocco and gold and have been prepared with an idea of making a lasting work which will be creditable in any library.

Dr. Frank W. Gunsaulus, president of Armour Institute, has acted as the editor-in-chief in the preparation of this work, and the corps of assistants, numbering 37, includes men of recognized standing in the several branches of engineering which they have treated. The several volumes are well printed and the matter contained within them is well arranged.

The subjects treated in the several volumes, from which an idea may be best obtained as to the ground covered by the library, are as follows: Vol. I: Mathematics; Vol. II: Mathematics, Mechanics, Heat; Vol. III: Foundry, Forge, Machine Shop; Vol. IV; Marine and Locomotive Work; Vol. VII: Electricity, Generators, Motors; Vol. VIII: Electricity, Light, Power; Vol. IX: Heating, Ventilating, Plumbing; Vol. X: Mechanical Drawing. The price complete is $40.00.

The American School has prepared this reference library of Modern Engineering Practice with more especial reference to usefulness in the hands of its students and graduates during their course of study and in practical engineering work thereafter. The average practicing engineer, however, will hardly fail to find between the front cover of Vol. I, and the back cover of Vol. X much, not only of interest and value, but of news as well to him. The work in general is founded upon the elaborate system of instruction papers used by the American School in its instruction by correspondence. As is well known, the instruction papers of this institution have been prepared with great care by some of the most eminent engineers and authorities in the several lines and subjects taught, so that this compilation therefrom, embodying the valuable portions of the regular courses of instruction, is certainly worthy of respect and confidence in its value as a reference work. It should be understood, however, that much time and considerable expense has been expended upon the preparation of the library and that it is by no means to be regarded simply as the regular series of instruction papers bound together.

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The International Printer

Published Monthly at the Lippincott Building, Philadelphia, Pa. Price $2.00 Per Year. Single Copies 25 Cents

The highest standard of the printers' art is exemplified in the September edition of the International Printer. The work is a typographic souvenir of the United Typothetæ Convention held in Pittsburg, September 1st, 1902. Too much credit cannot be given the publishers for the ability displayed throughout the book. From the cover to the finis there is a profusion of the latest demonstrations of the engravers' art, combined with innumerable instances of the marvelous resources of the printer in illustrative work by means of the printing press. Anyone intending having such work done cannot do better than obtain a copy of this edition.

Beginning with the title page, containing a special production for the occasion, printed in three colors and gold, and continuing through the book, one finds an effective use made of the illustrator's art in combining colors seldom equalled. The marginal allotments made for the different cuts, representing different subjects, depict artistic taste and unusual ability by those who arranged the work—contrast and harmony prevailing throughout.

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A cement for pipe joinits that is said to be as good in a faced or rough flange joint as red-lead putty, at one-tenth the cost, consists of a mixture of ordinary pine tar and dry oxide of iron. It does not harden as soon as red-lead, and is very adhesive under pressure.

Horse-Power as Applied to Boilers

By R. T. Strohm

It was in 1876 that the Committee of Judges of the Centennial Exhibition, in an endeavor to obtain a standard whereby the performances of competing boilers could be determined and compared, formulated the first generally accepted statement of the value of the boiler horse-power. It was to the effect that 30 pounds of water per hour evaporated from a temperature of 100° F. into dry steam at a gauge pressure of 70 pounds per square inch, should constitute one boiler horse-power.

This was, at that time, a most satisfactory standard, and served its purpose admirably. The reasons are not difficult to guess. In the first place, the steam pressures of that day averaged about 70 pounds; the feedwater heaters, owing to their imperfections, gave about 100° F. to the feedwater under usual conditions of practice. These facts account for the use of the terms "70 pounds gauge" and "a feedwater temperature of 100° F." The reason for fixing the evaporation at 30 pounds of water per hour lies in the fact that, the average steam engine of that period, working under ordinary conditions of service, required 30 pounds of steam per horse-power per hour.

The points to be particularly noted, then, are that the value of the boiler horse-power, as first stated, was made to conform to the conditions of practice which were considered good or reasonably fair a quarter of a century ago. Under such circumstances the selection of a boiler for a given engine did not involve so much study and calculation as must be put forth at the present day. For, according to the very definition of the term, a boiler horse-power was sufficient to produce a steam engine horse-power.

This is far from being the case at the present time. Twenty-five years of experience in steam engineering has caused a remarkable change in the status of things. Pressures of 70 pounds are matters to be discussed in reminiscential strain when the usual gauge reading varies somewhere between 100 and 200 pounds.

And again, imagine the reception of the salesman who should attempt to persuade the live engineer of the present to purchase a feedwater heater which would supply water to the boilers at a temperature of 100° F. The picture becomes all the more ludicrous when it is remembered that feedwater temperatures of 200° and over are not by any means rare in these days.

The question naturally arises, then, as to what significance the term horse-power really bears at the present time? The answer is as simple as the statement of the question. The term is misleading and obsolescent, if not indeed obsolete.

It cannot be denied that the steam boiler has such a property as horse-power. If it generates a certain number of heat units per hour as steam, it can be said to possess a definite horse-power. But the expression of the horse-power in no way whatever offers any comparison or definite relation to the horse-power of the engine.

When an engine is to be purchased for a given work, the builders specify its power under given conditions, and the number of pounds of water per hour required by it. The next step is, of course, the selection of a boiler which will supply the necessary steam to this engine. And here is where the first snag occurs. The boiler horse-power is one thing, and the engine horse-power is another, totally different. The former is equivalent to 33330 heat units per hour, while the latter is equivalent to 2545 heat units per hour. It is quite natural, then, for the uninformed to ask, why the boiler horse-power is so called when it is not a horse-power?

Before the size of the boiler required can be determined, it is necessary to reduce its duty to heat units per hour, in order to compare it with the engine horse-power. Since such a step is necessary, and since the word horse-power as applied to the boiler is a thing which outgrew its usefulness two decades ago, why should not the term be dropped altogether from the vocabulary of the present day engineer, in so far as it refers to the duty of a steam boiler.

There are other terms which are more rational, more reasonable, and more applicable in every way. The steam boiler is an evaporator of water. Why then not, adopt the unit of evaporation as the measure of boiler duty? The term has been recommended by the leading society of mechanical engineers of this country, and while there are still some old fogies who still cling to the term horse-power, the consensus of opinion regards the latter with disfavor, and it certainly must be thrown into disuse at an early date. The rapid progress in steam engineering serves to accentuate daily the ever-increasing absurdity of the word as used in this connection.

The unit of evaporation, on the other hand, does express a relation which is reasonable. It is the evaporation of one pound of water each hour from and at a temperature of 212° F. A more rational term could scarcely be conceived. By its use, the boiler power could be quickly and easily transformed into such shape as to allow ready comparison with the steam engine to which it must furnish steam.

It is persistently argued by some men whose experience as steam engineers should have taught them better, that a boiler does possess horse-power, and that therefore the usual term is an appropriate one. Ths first statement is undoubtedly true, in a measure. For the boiler does generate and store up in the steam a certain definite number of heat units per hour, which, when reduced to foot-pounds per hour by means of the mechanical equivalent of heat, will give the horse-power equivalent of the boiler duty. This will *not* be the boiler horse-power, however, as based upon the standard of 34½ units of evaporation per hour. It will be the amount of power which the boiler is capable of producing each hour provided all the heat generated is usefully employed in doing work.

The common expression "boiler horse-power" conveys no idea of the actual power which the boiler can develop, as one would be led to think upon hearing that term so applied. It is *not* a measure of the power at all, but instead it is a unit of capacity or size, and inasmuch as it masquerades under a title whose original and most widely accepted meaning is "a rate of doing work," it is evident that the term is neither appropriate nor useful at the present time.

The whole secret of this righteous opposition to the use of so misleading a term lies in the fact that it is ambiguous. In one case it represents power and in the other case it represents merely capacity or rating. So long as it is used in two senses so widely different, so long will this misunderstanding exist.

The question is by no means of recent origin. It has been discussed pro and con with unabated vigor in the columns of

our engineering magazines and journals until it would seem that it had been thoroughly threshed out. However, this is quite evidently not the case, when, in a recent issue of a well-known and widely read journal, a writer makes the statement that inasmuch as belts and shafting and pumps are spoken of as having horse-power, surely the steam boiler cannot be excluded.

This writer's reasoning is at fault in that he makes no distinction between the two uses of the term horse-power. The shafting, belts and pumps possess horse-power because they possess the capability to transmit a definite amount of power and hence they employ the term horse-power in the rightful sense of a work rate. But when the steam boiler is stated to have, say 100 horse-power, it is not meant that the boiler can do work at the rate of 3300000 foot-pounds per hour. Instead, the idea to be conveyed is that the boiler possesses the capacity to evaporate 3450 pounds of water per hour from and at 212° F.

The use of the same term to apply to two totally different things can never be reconciled, and the sooner the phase "boiler horse-power" is disused, the better for all concerned.

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LETTERS FROM ENGINEERS

In order to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories and general engine room experiences are especially solicited.

If at First You Don't Succeed, Try Again

Editor PRACTICAL ENGINEER:

If you think it worth while to publish an occasional article of the kind, I will be glad to contribute from personal experience, and hope such matter will be of interest and benefit to others.

To show what small matters sometimes occasion considerable anxiety and worry—as well as work—I will relate my experience with a Dean pump which had refused to operate through some disarrangement of the working parts. At the time I was employed as machinist at the plant and was called upon to examine it, but not until almost everyone else had had a try at it, and, if possible, detect and remedy the trouble.

I first took the bonnet off the water end enclosing the valves; I could see nothing wrong there and replaced the bonnet and turned on steam; but she wouldn't budge. I then examined the steam chest and found the valves there not quite properly divided; this I rectified and with an air of assurance I turned on the steam but not a move did she make. I now began to feel somewhat crestfallen, but took another try at it by taking back end of steam cylinder head off and also the follower, and Eureka! There was my trouble; I found that all the spirits of the rings had gotten together. After properly placing them, I again essayed to start her going, and this time with success, the action being as perfect as could be desired.

Yours Occasionally.

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"Grease Versus Oil"

In reading over the many letters of interest which appear, from time to time, in the columns of "The Practical Engineer" I find much that interests and instructs me. In particular I have studied the letters of your last two issues in one of which appears an article by S. L. H., under the caption of "Grease Versus Oil," and in the latter a criticism upon the same, by Charles Everly Carpenter. Now I am not upon record as an expert upon the subject of lubrication, but I am going to take advantage of the opportunity to criticise the articles, not for the mere sake of criticism, but in order to get the facts before your readers upon this subject.

Mr. Carpenter in one part of his article makes the statement that grease is a refrigerant and that it does not reduce friction; he further states that he has grease in use upon his automobile, rather that he may be assured of returning home without a hot bearing, than that he reduce the friction load; to quote him he says, "What matters it to me whether I am using a quarter horse-power or more by using grease so that I am sure of getting home under my own power." Now I feel sure if Mr. C. E. C. would have thought a moment he would not have made such a statement. For instance, he must know that where there is friction there is heat—that is one of the unalterable features of nature. There is just two ways to reduce such heat, one is to apply locally some means of removing the heat units as fast as created, in other words apply a refrigerant; the other is reduce, or remove the frictional cause of the heat. It must be remembered that the refrigerant does not reduce the friction, it simply reduces temperature.

Now let us analyze grease in order to dispel Mr. C. E. C's opinion that it is a refrigerant. We find it a matter maintaining about the same temperature as the atmosphere surrounding it, and subject at all times to any fluctuations in the temperature either high or low; if such is the case then wherein could it act as a greater refrigerant than the common air of an equal temperature? No, the properties of grease are not in any sense refrigerative—there can be no refruiting the statement that a refrigerant must possess a much lower temperature than the surrounding conditions—this grease does not possess.

Here we come to the latter part of Mr. Carpenter's statement, namely that he does not get home with cool bearings despite the fact that he uses grease. Now he states that there is a friction load in his bearings, but if there is friction there is heat in exact proportion to the amount of friction. The only way to reduce the friction, and the only way I know of now, to do this, is to introduce a film of oleaginous substance between the bearing surface. It matters not what it may be—so long as it is not injurious to the metal. If the heat does not oocur there must surely be an absence of friction—in other words cool bearings. We have Mr. Carpenter's word that the grease does keep his bearings cool, hence by a trifling study of the laws of nature and the application of a little common sense one must see that the grease is on a par with

oil in any particular instance where the bearings in either case remain properly cool.

It is not my desire to harshly criticise Mr. Carpenter, and the above statements are those of facts rather than of criticism. It is quite possible that Mr. Carpenter has found grease to be an article seldom to be depended upon as a friction remover ; the only real objection I find in his article is that he includes all grease in his category and not—as he should—the kind of grease he is accustomed to using alone. I will say right here that there is no dearth of such products upon the market, but it is not to be presumed that a grease used for farm wagons would act with any degree of safety upon our engine bearings.

It is seldom that we find an oil house producing grease of a qualiiy that will cause it to conflict with the sale of oil, and it is hardly to be expected that he would do so. We might rather look for the oil producer to manufacture a grease that would condemn its use than otherwise. All greases look alike, but all greases do not act alike, nor are all greases made alike. Hence it becomes one to ascertain the virtues of the better grades before condemning all alike.

The oil house as a rule sells a grease because there is a demand for grease, and because he has a residue left over from his oil making material which is more profitable to sell than to throw away—it would be better for the consumer if he did the latter—but the manufacturer of grease, and grease alone, endeavors to manufacture an article which will ensure him future customers ; consequently he leaves no stone unturned to compile materials very much above the refuse from oil making products. Practical experience is our greatest teacher, and I have no doubt that many engineers can be found who have experienced the difference between the lumpy, wet, soggy grease frequently sold by the oil house and the smooth products offered for sale by those depending upon the quality of their grease output for commercial success.

Respectfully yours,

CHAS. A. HOPPER.

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Triumph of a Philadelphia Inventor

Edward J. Moore, M. E., of this city, inventor of water-tube boilers, having obtained some twenty-six valuable patents from our Government, and several others in Europe on water-tube boilers for land and marine purpose, had given up the manufacture of these boilers of his inventions on account of the numerous applications he received from manufacturers throughout the country for licenses to build steam boilers under the protection of his exclusive patents by the payment of royalties and guarantees.

Among others that Moore gave a license to was the York Manufacturing Company, of York, Pa. They agreed to pay a guaranteed amount, but later refused to build the boilers and would not pay the guarantee, but set up the plea that the patents were an infringement of other people's patents, and they employed a legal attorney here and a leading patent attorney and expert of New York City, together with his assistants, to break down the patents. They failed to prove the invalidity of Moore's patents, and made settlement of Moore's seventy-five thousand dollar claim.

Mr. Moore has now purchased the Anderson property, Wood Street, above 22d & Carlton Streets, in this city, to take up again the manufacture of water-tube boilers on his own account, and declines to give any further licenses for land boilers, and all licenses in the United States have been cancelled by him.

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QUESTIONS AND ANSWERS.

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers with questions, he especially desires the readers in such cases to contribute any further information in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communications.

Editor PRACTICAL ENGINEER :

Is it not possible, on a Corliss engine, to reduce the lap on the valves and to throw eccentric back to get a longer cut-off and thus carry more load? What is the latest practicable cut-off with a single eccentric? PATRICK AHAESY.

1. It is.
2. Usually about $\frac{7}{8}$th stroke. Editor.

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Editor PRACTICAL ENGINEER:

Can you inform me of the proper manner to remove large belts?

My belt is thirty-five feet long, with the band wheel on a horizontal shaft, and the counter shaft pulley is vertical, how can I fix a tightener on it? Also which is the best lacing for belts, wire or leather?

The proper way to remove a belt of any large size, is to unlace it—you thus save time and avoid possible complications. In placing a tightener, you will have to do so by observing the hang of the belt and adjust the idler at the proper angle to take up the slack. Wire lacing is usually considered superior to that of leather; but, it must be put in with great care in order to have it draw evenly. Editor.

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Editor PRACTICAL ENGINEER :

Please inform me in your next issue, what are the proper tools to use in chipping cast-iron, such as cutting a dove-tail groove in a cast-iron cog-wheel, in order to replace a broken tooth. A Constant Reader.

We know of no special chisels for such use other than an ordinary cape chisel of suitable width to correspond with the size cut to be made, and a vigorous use of a file to smooth up with. Editor.

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Editor PRACTICAL ENGINEER :

I am a reader of your valuable magazine and take the liberty of asking you to reply to the following inquiries in your next issue :

In connecting a pair of magnetizing coils, used in magnetizing a bar of steel or a horse-shoe, to a battery of three or four cells (sal. am.), how can I find out which is the North or South Pole, and the positive and negative?

J. T. JONES, JR.

You are referred to an article appearing elsewhere in this edition under the caption of "Notes from the Dynamo Room." This will answer in detail the questions asked.

Editor.

400 Feet Fall of an Elevator Without Injury to Its Occupants

With the progress of the 20th century has come the sky-scraper, and with the advent of the sky-scraper has come a multitude of devices, of one sort or another, for the prevention of elevator accidents, or drops, each appliance having more or less to recommend it, as many can attest.

There is no doubt that many lives are saved annually by the prompt operation of the safety clutch, in cases of accident; but there are also numerous instances where the failure to operate of the, so called, safety clutch has been the cause of disastrous falls, maiming and killing many persons.

Prior to the inauguration of the high buildings of present dimensions the fact of a failure of the safety appliance was looked upon, more or less, as an evil beyond remedy; but with our present elevator shafts, ranging in height from 30 to as high as 450 feet, came a realization of the awful consequences of a fall to the bottom. Hence, in order to secure the successful tenanting of such places, it has become necessary to secure some means to allay the apprehensions of the most timid. In other words, some means must be made for absolute safety, something beyond the mere trusting to the prompt action of some mechanical appliance.

Again, it has long been apparent that the use of any "sudden stop" device is attended with considerable shock, no matter how quickly its action, for any heavy body under motion, if stopped suddenly, will produce a concussion commensurate to the velocity attained.

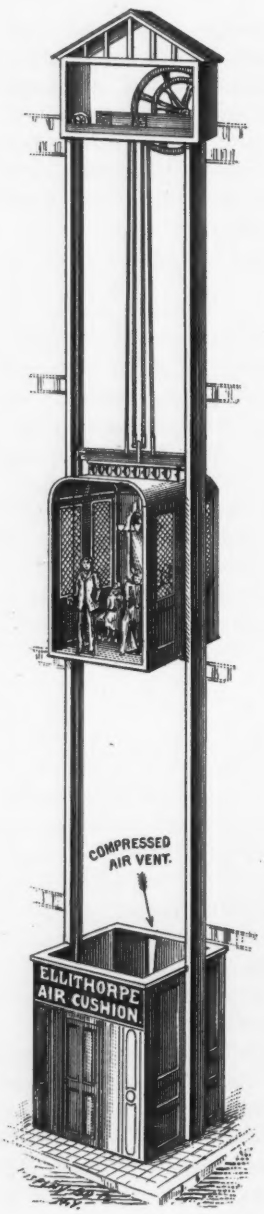
There can no longer be any excuse for the loss of life from falling elevator cabs, for it has been fully and practically demonstrated that the Ellithorpe "Air-Cushion" will effectually remedy this great danger.

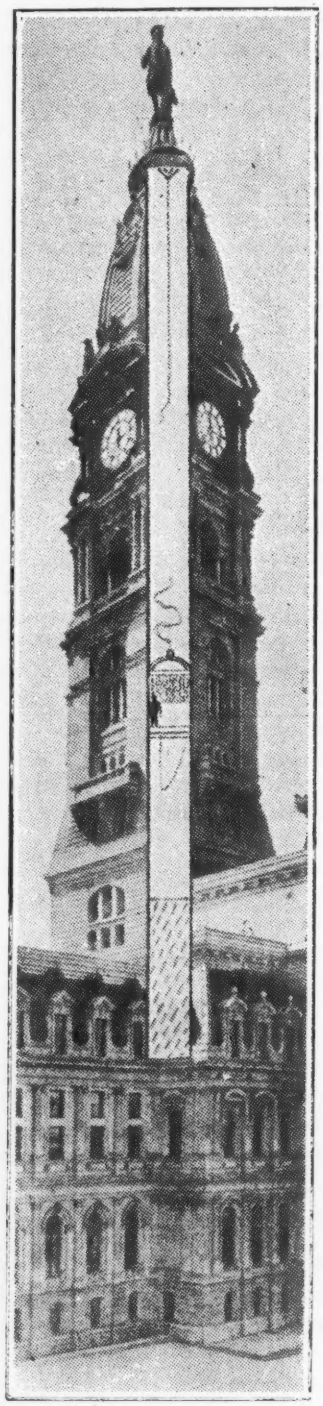
The Westinghouse Air-Brake upon a train of cars would be absolutely worthless without the watchfulness, caution and helping hand of the engineer to put it in operation. It does not of itself anticipate danger, or act of its own accord when danger comes. But the Ellithorpe "Air-Cushion" anticipates the danger instantly, and acts of its own volition without the intervention of any human agency or watchfulness; it makes the elevator car itself the guardian of its own safety. This invention is an achievement that renders harmless the law of gravity in the sudden descent of elevator cabs, by compelling the speed of the car to watch and control the law of gravity in its ever persistent force and power of attraction. A full appreciation of the merits of this "Air Cushion" can be had from the accompanying illustrations and description of a test which was made at the Philadelphia City Hall during the latter part of September last.

The verdict of the experts present was unanimous that the invention is a complete success, and hereafter no elevator will be considered perfect without it. The principle is that of an air-cushion of compressed air, which is forced into an air-tight well at the bottom of the elevator shaft by the downward rush of the car, gradually reaching a degree of compression sufficient to check the fall of the car and bring it to an almost gentle standstill.

On the floor of the car, which weighed 2400 pounds, was placed a number of live rats, several dozen raw eggs and a lot of incandescent light globes. The car was then run up to the top of the shaft, 499 feet 11¼ inches above the pavement. The accompanying illustrations show a cut of the tower with the shaft outlined; this will give the reader some idea of the terrific speed attained by the car, upon being cut loose at the top, when nearing the bottom of the shaft.

At a signal the rope suspending the car was severed and its fall began. There was a hiss, increasing in volume to a roar,





CITY HALL, TOWER, PHILADELPHIA.

then a bang and crash as of the breaking of a hundred window glasses as the car passed with frightful rapidity into the mouth of the air-cushion. It seemed as if the tower walls were tumbling down. The bottom had been reached in less than two seconds—think of it, over 400 feet drop—then there was a

rush for the bottom by the spectators who were at the top of the shaft.

The speed of the car had been so great, the shock of stopping was so terrific, that scarce a spectator but would have wagered a new hat against his vote for the machine candidate for Governor this fall, that there wasn't a splinter of the car left larger than a lead pencil, and as for hens' eggs, glassware and etc.,—the idea; harveyized steel couldn't stand such a shock. At the door of the elevator the spectator, with a shudder of apprehension, paused, then looking into the car as the door slid open, to see the rats running around in their cages, seemingly in wonder at so much commotion and eclat, the eggs were just as they were placed, and, in fact, from the appearance of the car, one would have been as safe in it during the drop as he would be in any other place.

The air-cushion, which stopped the car, was compressed by its descending rush at the bottom of a well 84 feet deep. Beginning at the top of the well and going down, the elevator shaft is air-tight, and its sides are lined with sheet-iron capable of resisting a pressure of 15 pounds to the square inch. The car does not perfectly fit into its shaft during the first 15 feet of the well, a space being left at the sides for the air to escape. This makes the stop more gradual. Otherwise the car would rebound as a rubber ball when it struck the wall.

At thirty-five feet from the bottom the car fits tightly into the shaft, and the compression of the air beneath it begins in earnest. A valve with a strong spring lets out the surplus air in the bottom of the well, permitting the car to stop with a gentleness truly wonderful.

Figure two will give one a very comprehensive idea of the construction of the air-cushion, which is a very simple appliance. Further knowledge of it can be had from the Excelsior Elevator Company, 1215 Filbert Street, Philadelphia, who are prepared to give estimates, etc., for their construction in all parts of the country.

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The "Monoplex" Telephone

Owing to the rapid increase of private line telephones, there is a growing demand for a first-class inexpensive telephone—that is, an instrument which "talks" perfectly, rings perfectly, which will not get out of order, and also finished in the manner that becomes telephone apparatus.

The Atwater Kent Manufacturing Works, of Philadelphia, has devoted a great deal of time and considerable expense to developing an instrument of this type, which is now being placed on the market under the name of the "Monoplex" Telephone. A number of advantages are claimed for this type on short lines.

The hook has a long lever, and consequently there is a maximum motion at the contacts with the least motion of the hook. The receiver is of the watch-case type, and aside from the rubber ear cap is one piece. There is thus no chance for a change in adjustment, or of parts becoming loose; there are no exterior binding posts connecting the end of the receiver cord to the box. This eliminates the danger of the cord becoming loose and the receiver is much more convenient to handle.

The finest grade of granular carbon is used in the transmitter, and it "talks" very distinctly. All connections are soldered, and the binding posts are so marked that there is no chance of mistake in connecting, and complete directions for setting up are sent with each telephone.

The telephone box is made of oak neatly finished, and the whole presents a very neat appearance. The "Monoplex" Telephone is admirably adapted for use in offices, factories, hotels, apartments and private houses.

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The Warren Webster--Feed Water Heater, Purifier and Filter

It is a recognized fact that feed water for boilers can be most advantageously purified by subjecting it to proper treatment before it enters the steam generator. A method now frequently used for this purpose is the feed water heater, of which there are many different types. There is no doubt of the value of this appliance as a fuel saver and no steam user ean afford to be without a heater. However, in a study of the various types, one will find such a wide and varied difference in their construction and also in their method of operation, that the question of which one to purchase must be determined by conditions. Heretofore, direct contact heaters have been looked upon with considerable disfavor because of the oil in the exhaust steam permeating the boilers, although their effectiveness is generally conceded to be high.

The Warren Webster Company, Camden, N. J., are making a heater of the direct contact type which they claim will remove all oil from the condensed exhaust. The illustration shows the style of this type of heater.

Materials used in its construction are cast-iron for the shell, copper and brass for the valves and fixtures, each of which resist the destructive action of impure waters. The large heating chamber—upper section of the heater—is provided with perforated copper trays for the distribution of water, as hereafter explained. The entire valve gear, automatically controlling the water supply, is of brass.

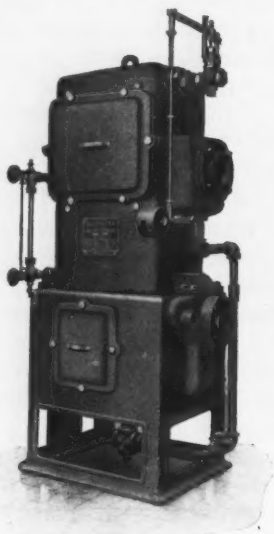
The heater has an inclined bottom to facilitate thoroughness in draining, and is amply strengthened for the pressures obtaining in ordinary practice. Access to the interior may be had by removing the man-hole doors located in both the heating and filtering compartments, the latter forming the heater base.

The water supply to the heater is controlled automatically, the valve for this purpose being operated by an open gravity sink attachment, by which the inlet of water to the heater is increased or diminished, as may be necessary to furnish the required amount of feedwater for the boilers, and also maintain a uniform water level within the heater.

Owing to the saving of water by condensing the exhaust steam used for heating, there is effected an economy in the amount of city or supplemental water required for the boilers of about 14 per cent., depending upon the initial temperature of the water supplied. Aside from its commercial value, this is an important factor in the purifying efficiency of the heater—it means that much less cold impure water with which to deal.

The feedwater enters the heater through the water inlet at

the top (the inlet being automatically controlled) and is discharged into and fills a trough, forming a water seal, thus preventing the familiar water hammer, which is caused by steam entering the water pipe when only part filled. The water overflowing from the trough is then distributed over a series of oppositely inclined perforated copper heating trays, above referred to, which, in their vertical arrangement, are staggered, so that the water in its downward course falls from one tray to another, and passing through the perforations is broken up in small particles, whereby it becomes thoroughly mingled with the exhaust steam and absorbs all the heat possible. In leaving the trays the water falls upon a division plate in the heater which separates the heating chamber from the filtering chamber.



The filter is located in the large lower casing, and operates in the following manner:

After becoming heated to the highest attainable temperature, as above referred to, the water in the heating chamber passes through a downcast pipe into the settling chamber, above which the filter bed is located. In this settling chamber opportunity is given for the precipitation and retention of the heavier solids and impurities without clogging the filter. On account of the large size of this chamber, the water entering it remains in an almost quiescent state, thus insuring the rapid deposit of the heavier solids from the feedwater.

The water then rises upward through the cast-iron perforated screens which holds the filtering material in place, through the filtering material and upper screens to the underside of the division plate, whence it travels to the pump outlet.

The steam supply is drawn to the heater through a branch from the main exhaust pipe, with a valve in it. This obviates the necessity of expensive piping, and further obviates the difficulty attendant upon taking all of the exhaust steam with its entrained oil through the heater. It also prevents the waste of water absorbed by the steam not condensed.

When it is desired to use the heater also as a "receiver" for condensation from steam heating systems, drying kilns, heating apparatus, etc., the steam supply coming from an engine working against back pressure, there is furnished and attached to the overflow connection a balanced float valve, and a specially designed copper pan or float connecting with and operating this valve. The float opens the valve in order to lower the water level within the heater when it rises beyond its normal height, the valve being normally closed to prevent a loss of steam through same.

When muddy, or water heavily charged with mineral deposits is used, filter beds very quickly become filled up and dirty. In order to overcome this objection this heater is so arranged that the water flow can be reversed and the filters washed out with no trouble, other than opening the valves to change the course of the inflow. Further description, with catalogue, etc., can be had by writing to the above mentioned address.

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The Lunkenheimer--Automatic Sight-Feed "Graphite" Lubricator

The tendency of the present period among steam users generally is toward higher pressures and often super-heated steam, and the use of oil as a lubricant is not entirely satisfactory in all cases.

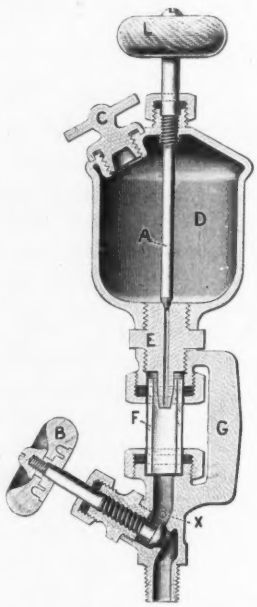
Powdered granite has long been known as a superior lubricant, having the peculiar quality of being adapted to be forced into the superficies of the cylinders and valves of steam pumps and engines, due to the motion of the moving parts, giving them a highly finished surface, thus reducing the friction and requiring very little oil.

While graphite possesses high lubricating qualities, at the same time it is not advisable to use it alone. It is therefore deemed a good practice to use in connection with the "Graphite" Lubricator either an Oil Pump or Sight-Feed Lubricator, and when this combination is effected, it is only necessary to feed about one-third as much oil as when no graphite is used.

Another valuable feature of graphite is that it fills up the crevices and interstices of the packings, thus the stuffing boxes need not be kept so tight and the friction on the rods and valve stems is lessened. It also increases considerably the durability of the packings.

While many engineers would use graphite, they have found considerable difficulty in procuring suitable apparatus for feeding it to the parts to be lubricated.

The accompanying cut shows an efficient feeder for this purpose manufactured by the Lunkenheimer Company, Cincinnati, Ohio.



The graphite is fed automatically and continuously in desired quantities, and visibly by passing it through a sight-feed. The cup requires but one connection to the cylinder, is very simple in construction, compact and ornamental in appearance.

The "Graphite" Lubricator should always be placed on the steam chest. On slide valve engines it is only necessary to use one cup, placing it about the middle of the steam chest, but on Corliss Engines it is best to use two, placing one over each valve. The operation is very simple, as will be seen by the following.

Close steam valve B and open drain plug X to allow steam to escape from cup; then close regulating valve A, remove filling plug C, and fill cup with graphite. After replacing plug, close drain plug, open steam valve (wide) and regulate feed of graphite by regulating valve. The sight-feed glass can be easily cleaned by opening drain plug. If necessary to

replace the sight-feed glass take cup apart by means of lock-nut E, and slide the new glass down through the opening.

As graphite is a very superior lubricant, and a small quantity will last quite a while, it is recommended to be used very economically, as a continuous feeding of same is not necessary, thus the feed can occasionally be shut off.

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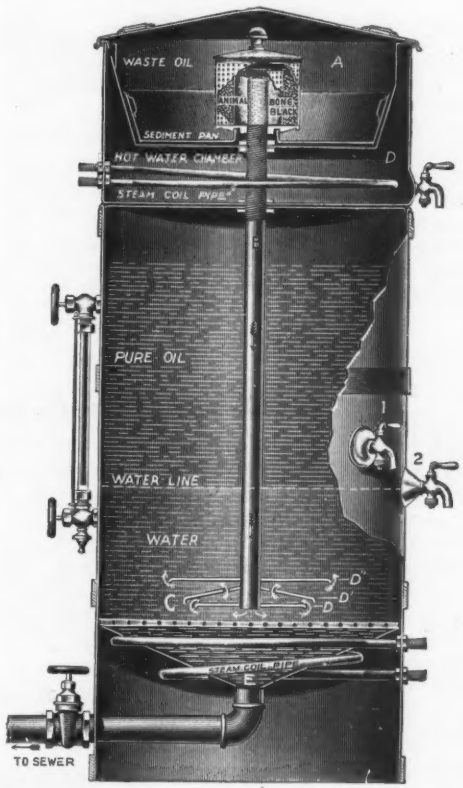
The American Oil Filter

A new oil filter, which has just been placed upon the market by the Burt Manufacturing Company, of Akron, Ohio, is shown in the accompanying illustration, and a brief description of the principles involved in its operation should be of interest to all readers who are familiar with the great possibilities for economy which are afforded by the collection of waste lubricating oil, and filtering it over and over until it has been entirely used up. The saving in this way often amounts to from 50 to 60 per cent., depending upon how carefully the oil is collected after having been used. This is an economy which is not generally overlooked in large plants, but the American Oil Filter is made in small sizes which are a profitable investment in connection with engines where even as little as two barrels of oil are used in a whole year.



This new filter has been especially devised by the Burt Company for the filtering of very heavy grades of oil which cannot always be successfully cleaned in an ordinary filter because of the liability to clog up. The claim is made that such oils are readily purified by this filter. The oil is heated and thereby thinned immediately upon being poured into the filter thus permitting rapid operation with consequent increased capacity.

By referring to the illustration, it will be seen that the pan for receiving the waste oil is surrounded by a hot water chamber, through which passes a coil steam pipe. When this chamber has been filled with warm water, and the lower part of the filter has also been filled with warm water until it flows from faucet 2, the filter is ready for operation, the proper steam connections, of course, having been previously made. The cleaning of the oil is then accomplished as follows:

Through the filtering material in the cylinder the oil makes its way into tube B and down onto the filter plate D, where the pressure of the oil above overcomes the resistance offered by the weight of the water, and the oil spreads out in a very thin film, becoming thinner as it travels from center to circumference of the plate. The oil is thus exposed to the action of the water. This process is repeated as the oil flows upon plates D 1 and D 2. The separation of foreign ingredients from the oil is thus made practically complete. Any remaining impurities then settle by force of gravity to the bottom of chamber E and are drained off by opening the valve. The pure oil is drawn from faucet 1.

Attention is called by the makers to the minimum of attention required by this filter. Any kind of filtering material may be used, or none at all, and the filtering material may be removed without interrupting the oil service. The method of cleaning the filter is very simple, requiring only that the cylinder at the top be unscrewed, the filtering substance removed and the sediment pan lifted out and emptied of the dirt and grit which has collected in it through force of gravity.

A distinctive feature of the American Filter is, the fact that the bulk of the impurities is collected at the top of the filter.

Further details with descriptive booklet may be had by writing the Burt Mfg. Co., Akron, Ohio.

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A new design of "turn-down" electric lamp is now being sold. The lamp is screwed into the socket like an ordinary lamp, no change being necessary, the base being standard. When the current is on the light can be changed without touching the bulb. Should the small light be wanted, by pulling the string with a tag marked "Dim" the desired light is obtained. For full light the string marked "Bright" is pulled, which gives a maximum illumination. The feature of this lamp is intended to be in its applicability to any style of fixture, no matter what posititon the fixture may be in, whether upright, downward or from the side, either open or inclosed shade, as the switch is so arranged that the string can be pulled from any angle, and the string is reached no matter how high the fixture may be. The lamp must be screwed tightly into the socket for proper light. This obviates danger of its working loose from the socket by the dffect of vibration.

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Harvesting in Lincolnshire, England, says the Westminster Gazette, has been conducted with the aid of a motor specially invented for farm use. After cutting a crop the motor draws the laden wagons from the field and is equally adaptable for chaff, pulping roots and grinding corn. The motor, attached to a reaper and binder, cut a field of barley at Tinwell in excellent style. The motor has been also tried with a double-furrow plow, and cut some deep and even furrows through oat stubble. It advantage over horse labor is that there are no delays through stopping horses or changing men, while the cost of fuel is considerably less than that for forage.

TRADE NOTES

A free sample.—The Keystone Lubricating Co., 20th and Allegheny Avenue, Philadelphia, are offering to send a free sample can of the well-known Keystone Grease, together with a Keystone brass cup to any engineer or steam user desiring to give it a trial. The expressage is prepaid. When writing mention The PRACTICAL ENGINEER.

A Lindstrom Separator attached to your steam main inside your boiler may save you a cracked cylinder head. In any case it will insure dryer steam with less impurities and less danger of cutting, with corresponding increased efficiency, with but a trivial cash expenditure. For catalogue, prices, etc., write John T. Lindstrom, 440 Liberty Street, Allentown, Pa.

The Atwater Kent Mfg. Works, of Philadelphia, who manufacture the Monoplex Telephone, have lately moved to 122 N. 6th Street, Phila., where they have doubled their floor space and state that sales of the Monoplex Telephones are increasing very rapidly. They are sending out to the trade a very nice little pen sketch of the Gibson type, free, upon request.

Geo. W. Lord has completed the addition to his large factory and chemical labratory at 2238–50 N. Ninth Street, Philadelphia, and is now producing larger quantities of the well-known Lord's Boiler Compounds than ever before. These compounds have been on the market for forty years and are known to nearly every American engineer. It is therefore not surprising to know that European engineers have also learned their value, and that Mr. Lord is now shipping many hundreds of tons annually to England and the continent.

This Company makes a specialty of analyzing boiler scale for engineers and steam users without charge.

Removal.—George E. Hubbert, the Philadelphia representative of the Pittsburg Feed Water Heater Co., has removed his offices to 931 Drexel Bldg., where he has larger and more convenient quarters than formerly.

Send for one.—Every progressive engineer in this country ought to have a copy of the steam specialty catalogue, issued by Watson & McDaniel, 147 N. Seventh Street Philadelphia, for it contains more things of genuine interest to an engineer than any small catalogue that has come to our notice. Moreover, each specialty is perfectly illustrated and briefly but comprehensively described. There are several styles of steam traps, two types of exhaust heads, a relief valve for water pipes, copper ball floats for high pressures, a great variety of reducing valves and steam separators.

The McDaniel Suction Tee, and the McDaniel Syphon or Water Lifter are specialties of more than ordinary interest, that can be used to many advantages. When sending for a copy of this interesting little catalogue, mention The PRACTICAL ENGINEER.

The Pulver Lubricating Compound, is one of the oldest and said to be one of the best lubricants now on the American market. Scores of engineers who have used it for many years attest its value and praise it very highly. Engineers wishing to try it for themselves will be sent a testing sample free of charge. Address Peter Pulver & Sons, 214 Franklin Street, New York City. Mention The PRACTICAL ENGINEER.

A new catalogue has been published by the Garlock Packing Co., 604 Arch Street, Philadelphia, and they are anxious to send a copy to every engineer who will take the trouble to write them. It contains forty pages of illustrations and good information concerning every variety of packing for high and low pressure steam, water, air and ammonia; also gaskets, pump valves, self-packing gauge glass preservers, metal polish, belt dressing, etc.

A handsome catalogue has quite recently been published by the Hayden & Derby Mfg. Co., 87 Liberty Street, New York. This catalogue is handsomely printed in two colors on the best quality of enameled paper with a handsome cover.

The goods, which are illustrated and comprehensively described, are the Metropolitan Automatic Injector, models "N" and "S," Metropolitan 1898 Injector, models "O" and "T" and the Metropolitan Double Tube Injector, model "G." The D. H. Ejector, used in various forms, and other apparatus is also shown. A great deal of useful information relating to injectors and ejectors is embodied in this catalogue, showing the results that may be obtained under various conditions. A copy will be mailed free to any one mentioning this paper.

Cross Oil Filters

Save Half on Lubricating Oil Bills

"OUR ENGINEER ESTIMATES that we have saved about 75 per cent. of our engine oil for use the second time with your CROSS OIL FILTER.

We cannot advise just how much this will amount to in dollars and cents, but consider that the Filter is giving good satisfaction."—AMERICAN TUBE AND STAMPING CO., Bridgeport, Conn., Sept. 11, 1902.

Cross Oil Filters are guaranteed to reduce lubricating oil bills, at least, 50 per cent. Let us send one on 30 days' trial, to be returned at our expense if it doesn't satisfy

THE BURT MFG. CO., Akron, Ohio, U. S. A.

Largest Manufacturers of Oil Filters in the World

Cross Oil Filters carried in stock by the

FAIRBANKS CO.

Sole Agents for Philadelphia

THE POSITIVE EXPANSION BOLT

Special Discount to Jobbers. Write for Prices

Manufactured by **D. C. SEAMAN & CO.**

1638 Hutchinson St., Philadelphia, Pa.

For sale by Neal & Brinke, 18 Warren St., New York; Somers, Fiths & Todd Co., 323 Water St., Pittsburgh, Pa.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 440 Liberty Street, Allentown, Pa.

DO YOU KNOW

That we manufacture chemical water purifiers that are guaranteed to prevent and remove incrustation in steam boilers, no matter what its composition may be.

CHEMICAL PURIFIERS

that do this without injury to the boiler, its fittings or connections;

CHEMICAL PURIFIERS

that can be used with perfect safety in Breweries, Ice Plants, Dye Works and all places where the water of condensation is used for any purpose.

Write for terms, reports, circulars, etc. We interest you and pay liberal commission. Agents wanted everywhere.

THE PEERLESS SPECIALTY CO.

852 Swanson Street,

Philadelphia, Pa.

The Engineer of the Jefferson Medical College, Philadelphia, says:

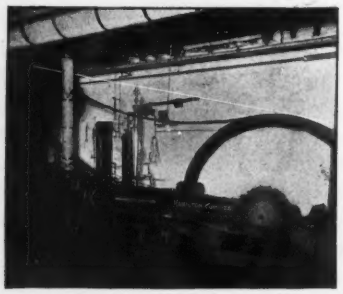
"This 12 in. belt, after using **CLING-SURFACE,** is doing 60 H. P., running 24 in. slack. With other belt compounds it would only do 45 H. P." The white line shows where it used to run. Pay for Cling-Surface only if O. K. after trial.

...TRY IT...

CLING-SURFACE MANUFACTURING CO.,

185-191 Virginia St., BUFFALO N. Y.

NEW YORK · · · PHILADELPHIA



The New Catalogue recently issued by the Pilley Packing & Flue Brush Mfg. Co., 308 N. Main Street, St. Louis, Mo., should be in the hands of every engineer interested in good packings and good tools for keeping his boiler tubes clean. In it also are described a number and variety of steel wire brushes not equalled by any other concern in the world. These brushes are adapted for almost every conceivable purpose and no engine room or factory is complete without them. The catalogue shows cuts of some forty different styles. Send for a copy free.

No Smoke.—The United States Mining & Trading Co., No. 11 Broadway, New York, have issued a booklet describing a stoker which they claim will burn the poorest quality of fuel without a particle of smoke. A copy of this booklet will be mailed free to persons mentioning this journal.

The Larkin Metallic Packing Co., 23 Imperial Power Building, Pittsburg, Pa., have had a number of very flattering, and some interesting testimonial letters reproduced in half-tone. These letters give the experience of the writers with Larkin Packing in various services, and will doubtless interest any engineer who is looking for a different packing from that he is using.

Free.—H. B. Underwood & Co , machinists, 1025 Hamilton St., Philadelphia, have had made to their order several thousand cigar perforators, one of which they will send free to any engineer or steam user who will send them his name and address. These little perforators are 3 inches long and are to be carried in the vest pocket. A hidden needle perforates the cigar by pressing a little spring. They are made of nickel and celluloid and are a decided novelty.

New Publications for Engineers

High-Speed Steam Engines

A Guide to English and Foreign Practice. By W. NORRIS, M. I. Mech. E., &c., and BEN. H. MORGAN. With Reproductions of over 130 Photographs and Drawings, and numerous Tests. Second Edition. Demy 8 vo., cloth, $2.80, mailed free.

"We can cordially recommend this book to anyone who wants to know all about high-speed engines."—*Electricity.*

Pumps:

Their Construction and Management

Graphically illustrating the different classes of Pumps, pointing out the advantages and disadvantages of each class, and giving hints as to management. By PHILIP R. BJORLING. Cloth, $1.00, mailed free.

Mr. Philip R. Bjorling is one of the greatest authorities on Pumps."

The "Engineering Times"

A Review of Modern Engineering Practice. Contains signed Articles by the most eminent Engineers. Printed in magazine form, and elaborately illustrated. Edited by BEN. H. MORGAN. 12c. monthly; mailed free, 18c. Annual Subscription, $2.25.

"The 'Times' of engineering," *vide Press.*

London: P. S. KING & SON

2 & 4 Great Smith St., Westminster

W. Clifford Smith, 45 N. 2d Street, Philadelphia, is making a specialty of grate bars of every description. He claims to have an exceptionally good bar for bituminous coal. He will quote prices to any one interested. Mr. Smith also makes special castings of every kind.

A handsome large catalogue has been issued by the E. J. Moore Machine & Foundry Co., 2227 Wood St., Philadelphia. It describes the various types of boilers built by the Company and will make a valuable addition to the library of any engineer. Copies will be sent to any of our readers upon request.

There is perhaps no better economy to the steam-fitter and the engineer than a perfectly tight joint, yet one that can be easily taken apart if desired.

It is possible to have such joints if Dixon's Graphite Pipe-Joint Compound is used. Flake graphite is impervious to the action of heat or cold, acids or alkalies. Hence the value of a graphite compound when properly prepared.

The Joseph Dixon Crucible Company, of Jersey City, N. J , will send booklet and sample free of charge.

POWER and high speed in modern machinery depend upon perfect lubrication. It is the solid lubricant that has made this possible. It is Dixon's Flake Graphite that has provided the best solid lubricant.

Send for Circular and Sample.

JOSEPH DIXON CRUCIBLE COMPANY
JERSEY CITY

$2.50 EACH

5.00 PER PAIR

MONOPLEX TELEPHONE. Talks Perfectly Rings Perfectly Perfect in every way.

ATWATER KENT
Mf'g Wk's
119 N. 6th St.,
Philadelphia.

When your elevator stops or gets cranky or don't work right, or even shows signs of not working right, don't take any further chances, get it repaired. The Keystone Elevator Inspection & Repair Co , N. W. Cor. 11th and Wood Streets, Philadelphia, are experts in that line and will do the work right.

Progressive Combustion of Coal is the title subject of a very interesting and instructive catalogue issued by the Green Engineering Company, 400-404 Western Union Building, Chicago, Ill. The Green Company manufacture a traveling link grate which they claim to be the acme of coal combustion furnaces.

Cochrane Heaters "Admirable Service"

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DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then, one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are required in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

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The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Maryland Council, No. 1, meets 2d and 4th Fridays in Royal Arcanium Hall. Chief Engineer, J. C. W. Schrier. Corresponding Engineer, Wm. S. Smith, 116 W. Lee Street.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Cheaspeak and Elliott Sts. Chief Engineer, Philip A. Kirkwood. Corresponding Engineer, Jos. H. Stallings 3032 Dillon St.

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Orange Council, No. 9, Meets 2d and 4th Fridays. Chief Engineer, Chas. Gartrell; Corresponding Engineer, Fred. L. Hale.

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Perth Amboy.

Stevens Council, No. 1, meets third Saturday, at Water, near Lafayette Street. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

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Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

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Millville Council, No. 6, meets every Saturday, 7.30 p. m., in G. A. R. Hall, East Main St. Chief Engineer, Geo. Esabel Corresponding Engineer, Lewis Doughty, 604 Mulberry Street.

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John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington Street. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange street.

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Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes Street, Pittsburg Pa.

Germantown Council No. 22 meets every Wednesday evening at Main and Seymour Streets, Germantown; Chief Engineer, John P. Rickards; Corresponding Engineer, Frank MacIndoe, 3529 Ainslie St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. 12th Street and Columbia Avenue. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Avenue and Master St. Chief Engineer David J. Ezrah. Corresponding Engineer, Charles Fournier, 3115 Richmond St., Philadelphia.

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(Continued on page 28.)

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Helping Hand Council, No. 12, meets every Thursday evening at Kensingon Ave., and C Streets. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2508 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Streets. Chief Engineer, Frederick Markoe. Corresponding Engineer, Walter Meyers, 1211 North Howard Street.

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Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, 2nd and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

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Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, Wm. R. Smith. Corresponding Engineer, A. P. Driesbach, 728 Chew Street.

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Pottstown Council, No. 14, meets first and third Saturday evening at P. O. S. of A. Hall. corner High and Hanover Sts. Chief Engineer, Joseph Rhoads, Corres., Engineer, H. L. Shirey, 302 Cherry St.

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Progress Council, No. 18, meets every Saturday evening at Diebert Hall, 9th and Penn Sts., Room 4. Chief Engineer, Geo. W. Miller. Corresponding Engineer, Frank S. Miller, 3 W Franklin St.

Chester.

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Clifford P. Williams Council, No. 2, meets every Thursday evening 298 4th Street. Chief Engineer, David T. Richardson. Corresponding Engineer, Jas. T. Harris, 1611 Clybourn Street.

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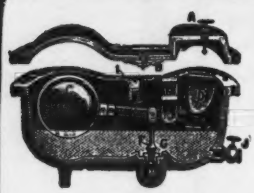

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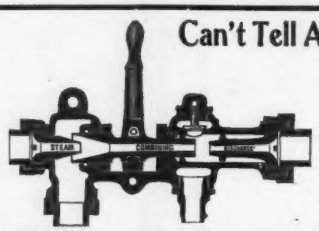

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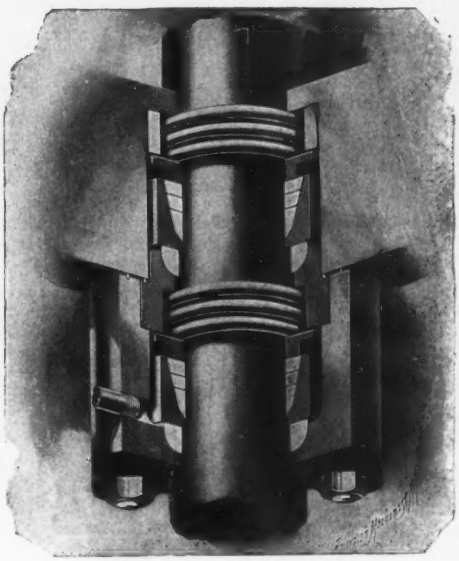

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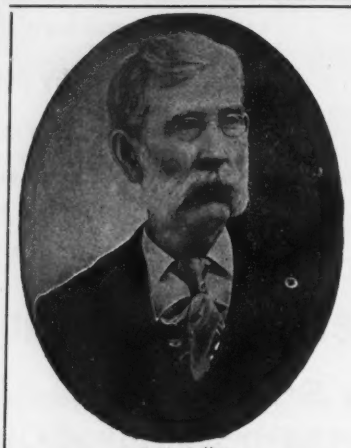

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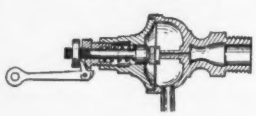

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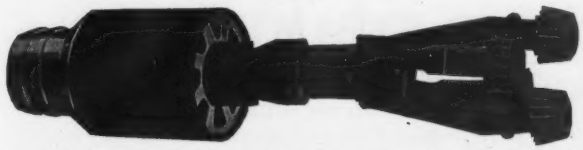

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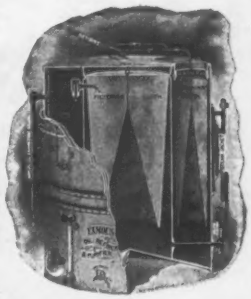

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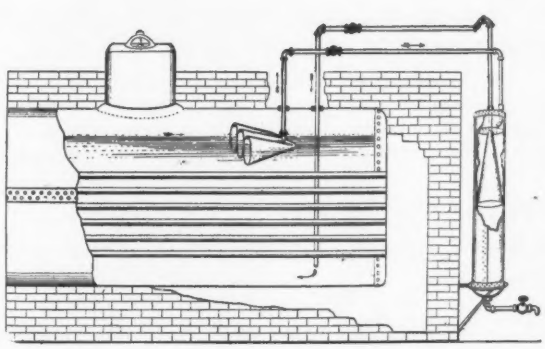

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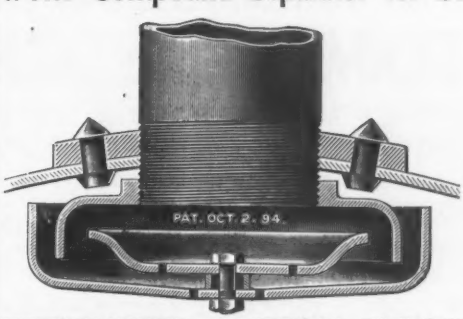

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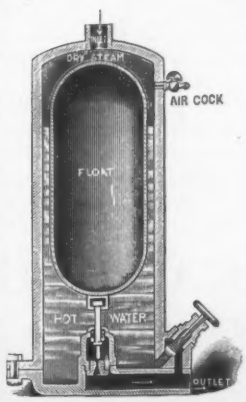

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PREFACE

The preparation of this book has occupied most of the author's spare time for a number of years. Originally the matter was not intended for publication, but the manuscript has grown so large and complete, which consideration, combined with many repeated requests, has induced the writer to publish the matter in book form.

Let every engineer make his own indicator book as he proceeds in his study and practice, and it will prove invaluable in after years. The present work has been compiled in this way, from data continually obtained during the author's professional career, extending over a third of a century.

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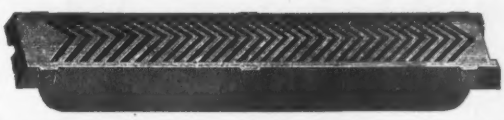

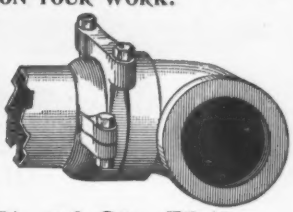

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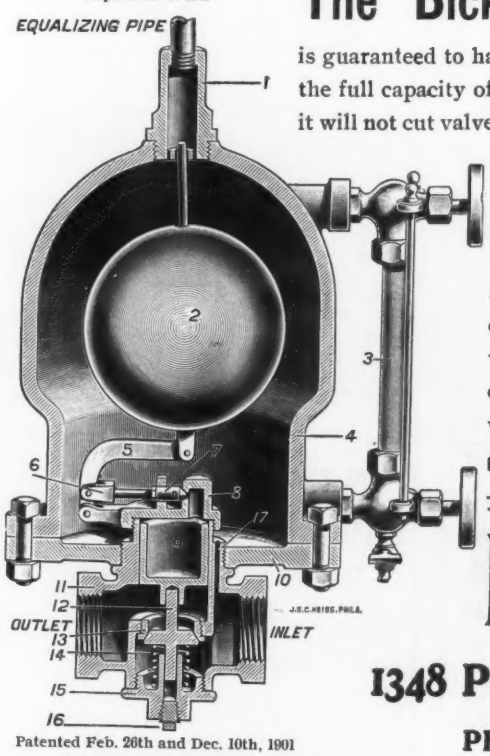

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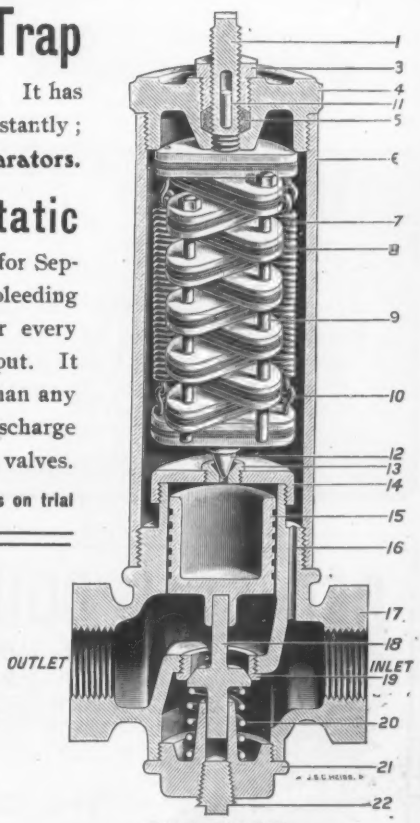

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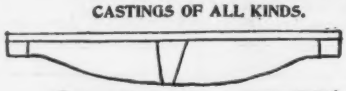

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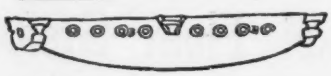

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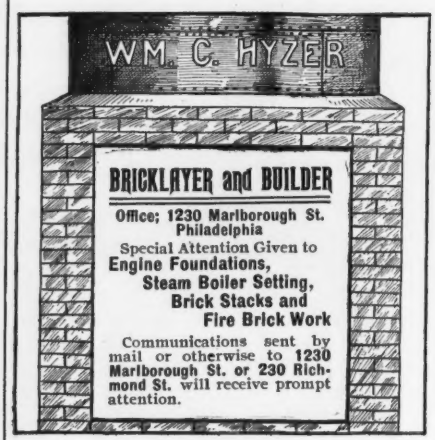
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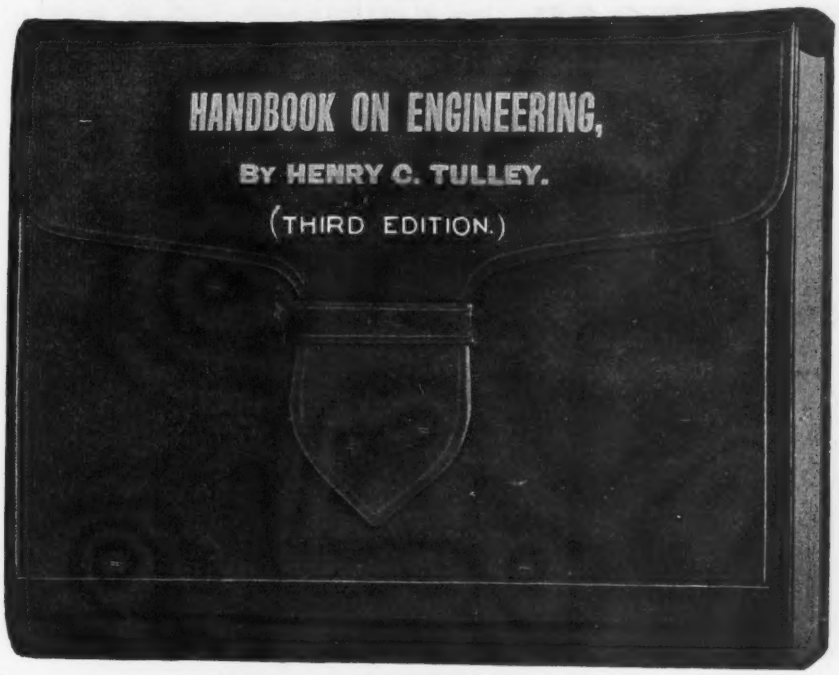

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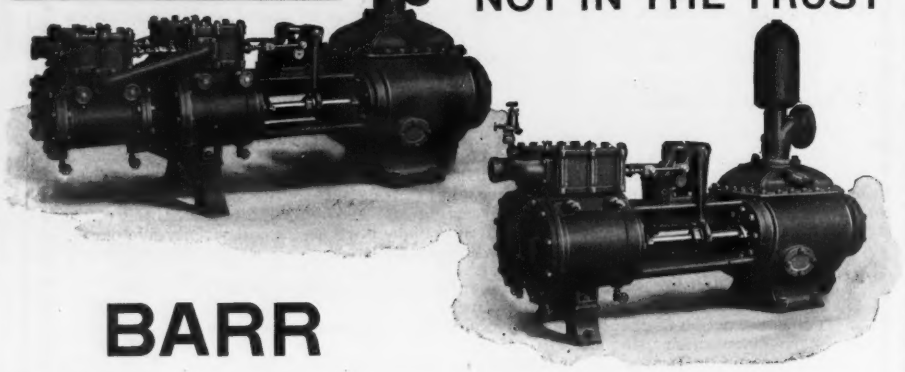

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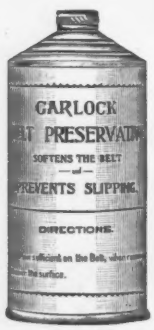

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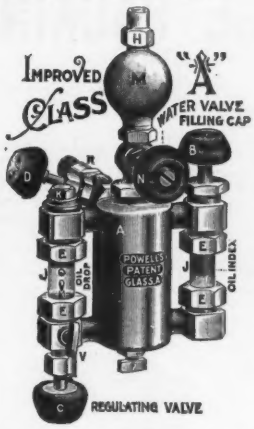

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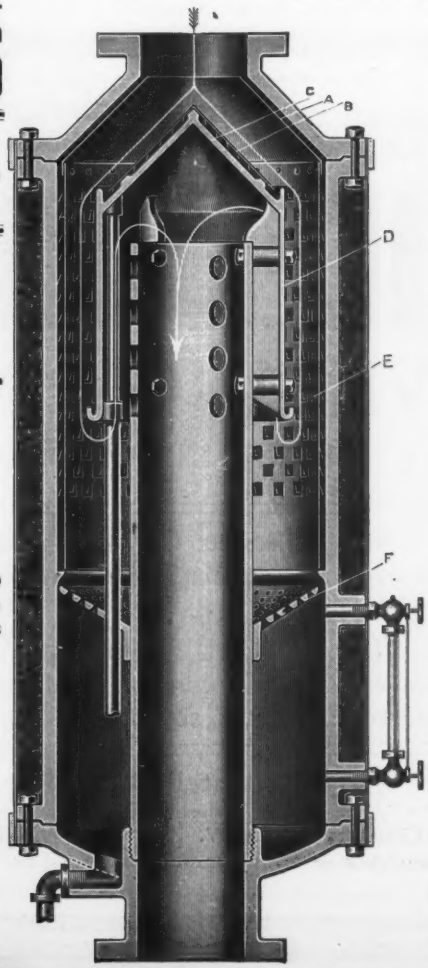

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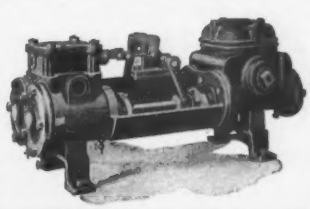

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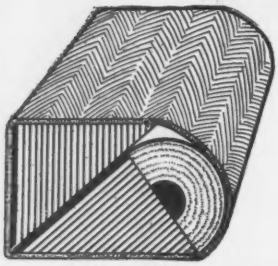

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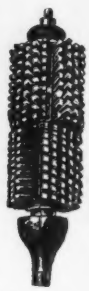

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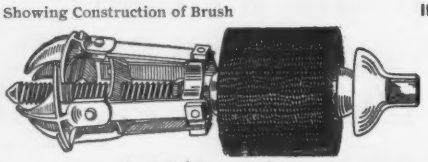

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SEE HOW THEY'RE PLACED!

Three grooves—two rings in each groove, one cut at an angle from center, the other straight from center. Where does the steam get through? It doesn't! That's why they've been adopted by large engine Builders everywhere.

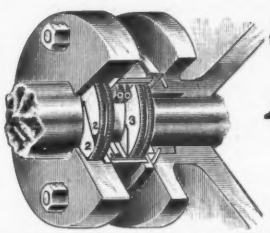
NOW THINK

of the Sunday afternoons spent in re-packing—the continual kick about soft packing bills—now wouldn't it just be as well to get our catalog? It's free.

France Packing Company, Inc.,

6514 State Road, Tacony, Philadelphia.

Our Guarantee



Is Satisfaction Or No Pay

This

Weinland Tube Cleaner

pleases everybody

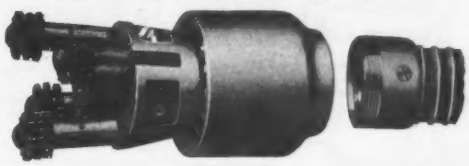
The man who uses it, because it is easily handled and

CLEANS TUBES CLEAN.

The Proprietor, because it

SAVES TUBES, LABOR, TIME AND MONEY

and greatly reduces coal bills.



It is strong and durable, outlasts several ordinary cleaners. Sent on trial. Our Patent Coupling is worth considering—one goes with every cleaner. Hose can't pull out, saves lots of time, worry and "cuss words." Write us about Boiler Cleaning. We're experts in that line. Had 20 years' experience and "know how."

The Lagonda Mfg. Co.,

Springfield, O., U.S.A.

SHADE & MARSHALL, Agts.,
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"STEPHENSON" BAR BELT DRESSING

Cuts Down the Bill

For new belting
And it is handy.
Make up your mind to test it for yourself.
Nothing to lose—everything to gain.

Drop us a line to-day

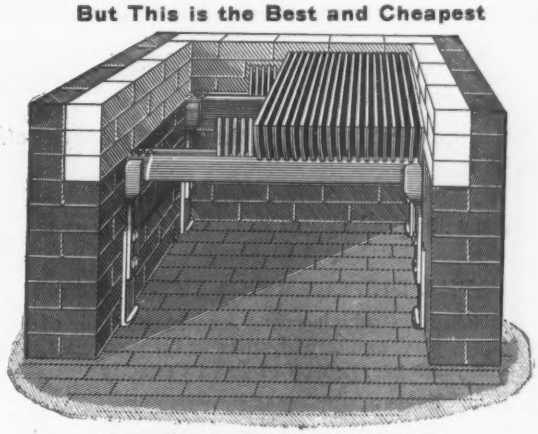
STEPHENSON MANUFACTURING CO.

ALBANY, N. Y., U. S. A.

WE MAKE ALL TYPES OF

GRATE BARS

But This is the Best and Cheapest



The Longest-lived Grate Bar That Ever Lived.

IMPROVED AMERICAN GRATE BARS

PATENTED

THE ONLY GRATE WITH ADJUSTABLE FRAME.
THE ONLY GRATE WITH LOOSE TEETH BETWEEN THE BARS.

We wish to call your attention to a few important points in our new Furnace Grates.

The adjustable supporting frame, not coming in contact with the brick-work, saves the walls from getting loose, and can be adjusted to any height desired. The perforated supporting cross bar has less obstruction to a free circulation of air than any other Cross Bar made. The movable teeth between the Grate bars can easily be changed at any time, so as to give an air space between the bars that is desired to accommodate any size of fuel; the Movable Teeth also give the bars more freedom to expand and contract, thereby the bars are less liable to warp.

The American Grate Bars have given satisfaction where others have failed. Are made and for sale only by us; other parties have no right to make or sell them. **Send for circular and references.**

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BUT NEVERTHELESS
A FACT

Some people will continue the use of old style soft packing

WHEN THEY CAN USE

A metallic packing just as pliable, just as easily put in place

STILL DIFFERENT IN EVERY WAY

A Packing in which every known principle of Lubrication, wear and adjustibility is fully covered, and by four years use, proven to do just exactly

WHAT WE SAY IT WILL DO

Can you do less than give it a trial, without risk to you, if it fails?

Circular and testimonials from well known parties furnished on application.

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No. 23 Imperial Power Bldg., PITTSBURG, PA.

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The Power Improvement Co.,

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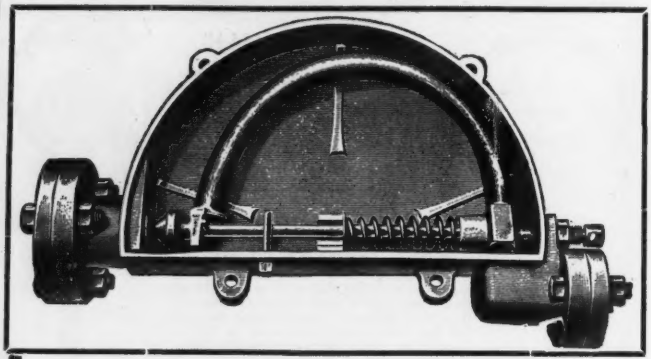

Who is Hurt?

WE don't mind imitations of the **HEINTZ** trap. We are not the ones hurt by them. We simply accept the compliment—and wait.

It's easy to make a trap that looks just like the **HEINTZ.** Many have tried it—and their traps are gone and forgotten. Other imitations are made under various names, being sold now to people who don't know that the essential secret of Heintz efficiency is in the sensitive compound that actuates the spring.

When the buyers have found them out, and spent good money to replace them with **HEINTZ** Traps, no doubt there will be a fresh crop of imitations.

And who will be hurt?

The HEINTZ Steam Trap is made in nine sizes; capacity 1 to 240 gallons a minute. Guaranteed for one year.

WILLIAM S. HAINES CO.

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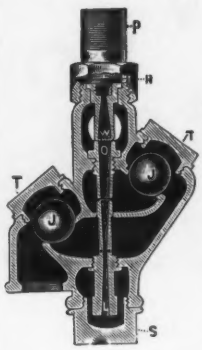
What Injector Can Beat This?



The Lee BALL VALVE AUTOMATIC INJECTOR

Regular Test—All Lee Injectors are tested in this manner, and a copy of the test accompanies each Injector.

1-C No. 11620

Starts low, 19 pounds On 74° Water
Works high 170 pounds On a 3 foot lift
Lifts hot water with 65 pounds steam at 123°
" " " " 80 " " " 124°
" " " " 100 " " " 122°
At 60 pounds steam pulls a vacuum of 24″ equal to 24′
" 80 " " " " " " 23″ " " 23′
" 100 " " " " " " 22″ " " 22′

WHAT INJECTORS CAN DO AS WELL?

MANUFACTURED BY

THE LEE INJECTOR MFG. CO.

99-103 ABBOTT ST. DETROIT, MICH.

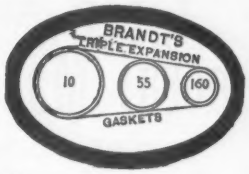
SELDEN'S PATENT PACKINGS

made either with **Rubber or Canvas Core** and both **Round** and **Square** in shape. Will give satisfaction on Engine, Pump, Compressor and Valve Rods. Easiest of all packings on your rods.

Brandt's Triple Expansion Gaskets

For Boiler Work and

Brandt's Hard Pump Valves



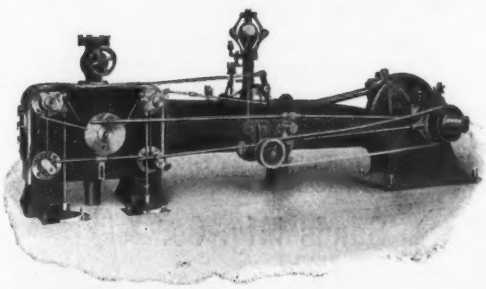
are the very best goods you can use in **High-Pressure** work. Engineers are requested to give the above a trial if they are not now using them.

RANDOLPH BRANDT

Sole Manufacturer and Proprietor

38 CORTLANDT STREET, NEW YORK

Atlas Engines and Boilers



We make many types and sizes of horizontal steam engines and boilers, but every one of them is the best that good materials and high-grade workmanship can make.

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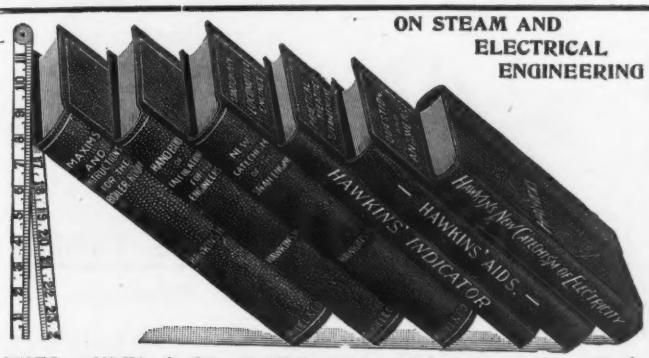

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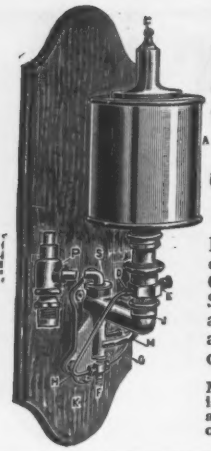

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The Simplest and Closest Damper Regulator.

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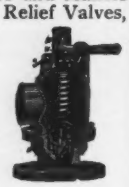
Brass Founders and Finishers and Makers of Pop Safety Valves, Water Relief Valves, Oil Cups and Lubricators, Steam Pressure Regulators and other safety steam appliances.



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is the best, most reliable, cheapest, and is so acknowledged by elevator builders and engineers who are using it. It does its work easier and with less trouble than any other device know to them for supplying elevator pressure tanks with air. If this INJECTOR does not give satisfaction after 30 days trial, same can be returned. A liberal discount quoted to the trade, also to consumers.

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illustrated here is designed for Single Engines or Large Plants where many Engines are operated from one steam main. It will oil one or a dozen Engines, save 40 per cent. of Oil used with any other Lubricator, and prevent annoying leaks in Steam Pipes.

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Best goods ever produced Every Engineer should try them

No dirt can reach the bearings from our oilers

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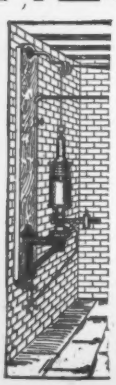

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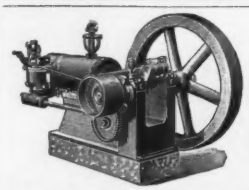
We manufacture the

IMPROVED KELLAM DAMPER REGULATOR



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Repairing of Electric Motors, Dynamos, Steam, Gas and Gasoline Engines, Automobiles and Machinery in General

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We Carry Repair Parts in Stock, and Will Work Holidays and Nights When Necessary

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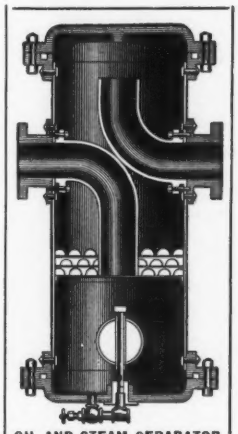
The LINDSTROM Steam and Oil Separators



OIL AND STEAM SEPARATOR

Will keep the water in your Boiler.
Will reduce the moisture ¾ of 1 per cent.
Will stop the priming in your boiler.
Impossible to get water over to Engine from Boiler.

It pays to remove the Oil from Exhaust Steam.

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Cylinders Re-bored in their present positions. From 4 inches to 70 inches.

ALL KINDS OF STEAM ENGINE AND STEAM PUMP REPAIRS. GENERAL AND SPECIAL HIGH GRADE MACHINE WORK.

SEND FOR PARTICULARS AND PRICES

FOR INTERIOR OF BOILER

Nazareth Electric Light & Power Co.
Nazareth, Pa., May 13, 1902.
Mr. John T. Lindstrom, Allentown, Pa.
Dear Sir:—With reference to your Separators which we placed on our boilers quite sometime ago, we beg to advise that our engineer reports that they are fulfilling all the requirements and all the claims made for them by you. He has experienced none of the old trouble since we have them on. Our engineer, who had at first very little confidence in them is now convinced that they are a "good thing." Yours truly,
S. C. WILLIAMS, Treasurer.

John T. Lindstrom

440 Liberty Street - - - Allentown, Penna.

HOUGHTON'S MONTHLY LETTER TO ENGINEERS

We want to write to you about steam traps this month. To impress upon you that there is such a thing as a good steam trap; one that will not go into your junk pile after a month or so of use.

Such a trap is sold by us and is called the MARCK STEAM TRAP.

Its phenominal success has placed it at the very lead of the steam traps of both Europe and America. This same success has made sellers of competing traps jealous. You know that when people are jealous they say things that they really do not believe themselves.

We pray you, therefore, if you want to know about the MARCK STEAM TRAP, send to us for the information and do not obtain it from these jealous competitors.

Here is what we think of the MARCK STEAM TRAP.

We will send to your firm from one to twelve, with the understanding that, if after using them for 30 days you are not satisfied with the results of their use, you can return all or any part not found satisfactory, and we will cancel the charge, or you can exchange undesirable for more desirable sizes.

If you accept the traps, we guarantee them against all defects in workmanship and material for a period of two years.

Now we have been making this offer right along each year and find that it pays. The returns are less than a half of one per cent. The claims on guarantee are almost unknown.

You, as a thinking man, must know that we could not continue to make such a liberal offer, were the returns exorbitant. You must also know that such a liberal offer is being largely and generally accepted; and the natural conclusion must be, therefore, that there are practically no returns and that the MARCK STEAM TRAP is giving satisfaction.

It is doing as we claim,—saving fuel, producing uniform heat, increasing capacity, saving packings and making life in the engine room happier in general.

The very first move for you to make in this trap matter is to obtain one of our illustrated MARCK STEAM TRAP CATALOGS, showing the various applications of the trap and stating plainly what the trap will and what it will not accomplish. With this catalog you can judge as to your requirements for a trial test, that is, the number and size traps you want, and order the same as per the above offer. If you have any difficult problem, and will submit to us the drawings, our engineers may be able to help you out. But send for the catalog the very first thing. Do it right now, while you have the facts and our address before you.

E. F. Houghton & Company

254 West Somerset Street **PHILADELPHIA**

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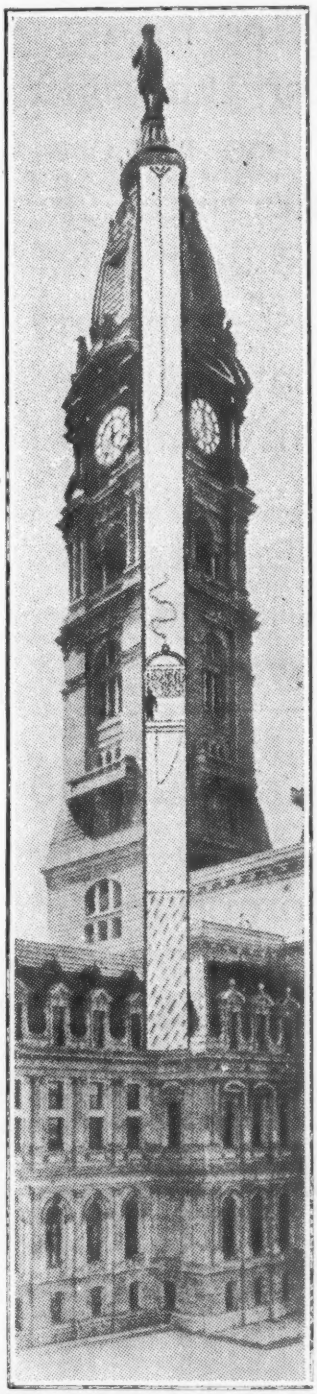
EXCELSIOR ELEVATOR COMPANY



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Automatic Car-Locking Devices
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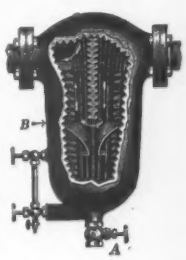
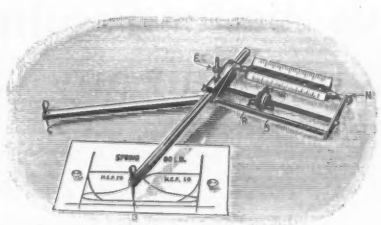
LABOR costs more than packing. It is the time required to repack cheap packing which makes it more expensive than Eureka.

WORK easier, pay better, advancement surer is the promise of the Improved Robertson-Thompson Indicator.

YOU should get the water out of live steam some way. The Hine Eliminator is the cheapest good way.





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The engineer who really desires to advance will be open to any proposition which promises to help him. Our catalogue is full of suggestions which will be appreciated by every bright engineer. Why don't you write for it?

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Consist of Crystaline Basic Salts, Soluble and non-corrosive. They come in a dry, granulated form.

When added to Boiler feed-water the right compound will immediately transform the mineral matters from hardened earthy elements into unhardenable earthy oxides, that are inert and completely rotted. They act on the incrustation and scale formation, just as nature through atmosphere and moisture acts on hard, even flinty mineral masses.

The scale or incrustation is transformed into a loose sediment like mud or silt, which is removed from the boiler by blowing-off and by washing-out at stated intervals.

LORD'S BOILER COMPOUNDS contain no water, give better results, and are far more economical to use than any Liquid Boiler Compound in the market.

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is **positively** the **purest** and **best lubricant in the world,** and **the cheapest.**
It is a strong assertion to make, but we know exactly what we say and, moreover mean every word of it.

NOW LOOK

KEYSTONE GREASE

when submitted to analysis was found to be absolutely pure grease without a trace of rosin, rosin oil, or mineral acids.

KEYSTONE GREASE

never changes in quality, it's always the same.

KEYSTONE GREASE

will not gum, harden, heat, scratch, wear or tear the journals.

KEYSTONE GREASE

is not affected by temperature. It will give perfect results under any and all conditions.
It never drips or wastes away—it is applicable on every kind of machinery, and wherever properly used, hot boxes are unknown.

One Pound of KEYSTONE GREASE

will do more and last longer than 3 gallons of the best oil, or from 3 to 5 pounds of any other grease made.
It is a pretty hard proposition to convince some people and we don't expect to do it by argument alone—we tell you facts—just as they are and prove them to you by actual demonstration. Send us your name, we'll send you **free, absolutely free—express paid—a large trial of KEYSTONE GREASE and a KEYSTONE BRASS GREASE CUP** to feed it properly.

This is a cut of the cup we send you FREE—together with a sample of KEYSTONE GREASE only send us your name, Mr. Engineer, that's all.

Keystone Lubricating Co.

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MOORE'S HIGH PRESSURE SAFETY STEAM BOILERS, 800,000 H. P. in use, both in Europe and America

Repairs of Water Tubes. Boilers of all types a specialty. We have special tools for this purpose.
We keep constantly on hand ready for shipment 1000 horse-power. There can be no delay. **Send for Catalogue.**

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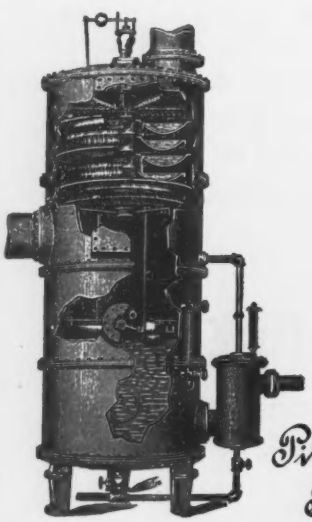

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Bonar Oil Filters.

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For All Classes of Steam Boilers. Well designed, compact, efficient, durable, low priced and reliable. In action it is easy to start, has large range of work, full capacity, is absolutely automatic, and the discharge can be graded within wide limits. All parts are well proportioned, strong and durable, and any worn-out piece can be easily and quickly replaced at slight expense. Starts low at 22 lbs., works high to 185 lbs. Feed water 76°, lift 3 feet, works without adjustment of steam or water at pressures from 60 to 180 lbs. Automatically restarts if operation is temporarily interrupted. Tubes are easily removable for examination or repairs by the simple use of a common wrench. Devoid of small parts which are easily lost or unreliable in action. Fifty per cent. more durable than any other machine of its class. Retains original efficiency under constant usage and slight wear on tubes will not impair its operation. Works well with hot feed water and on long lifts. Impartial tests solicited and satisfaction guaranteed. Specify the *Lunkenheimer* Automatic Injector and order from your dealer.

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6

We are the Originators, not Imitators

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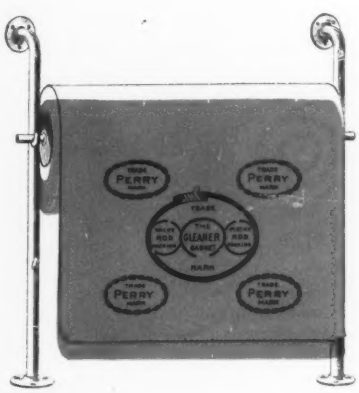
Perry's Red and Brown Sheet Packings



are the only old and original goods now offered to the trade, and that PERRY'S SPECIALTIES in Steam Packings, for all purposes, are made upon honor, have no superiors, and are guaranteed in every respect.

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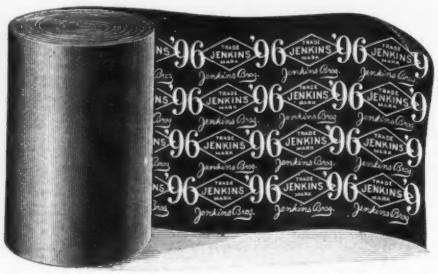
'96 Jenkins Standard '96 Packing '96

The Perfection of Joint Packing. Do not accept unless it bears our Trade-Mark as shown in the cut.

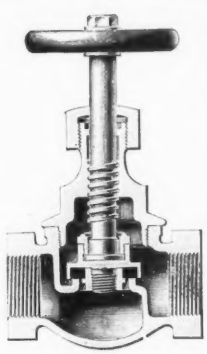


Use Jenkins '96 Sheet Packing on the worst joint you have, and if it is not what we claim we will refund the money.

JENKINS '96 PACKING has stood the most crucial tests under all conditions of service with steam, oils, acids, ammonia and the like, and in no case has it failed to make a perfect joint when properly applied. Can be placed in a joint either hot or cold, and will make joint instantly. Full steam pressure can be turned on at once when joint is made, it does not require to be followed up and will not blow out. It vulcanizes in place and forms a compound that will not rot or burn out, but will last as long as the metals which hold it. It joins with rough surfaces equally as well as when they are faced. **Jenkins Standard '96 Packing** weighs less than most joint packings. When compared with equal sizes of other packings sold at a lower price per pound, it will be found to cost less per square yard.

Jenkins Brothers' Valves

Design, workmanship and materials of the highest standard throughout. Every valve inspected and tested before leaving the factory. Made in all styles and sizes, both brass and iron.



Jenkins Discs

Do not be deceived when you are offered discs "just as good" or better than the Jenkins, as many worthless imitations of our discs are on the market. We are the original manufacturers of this class of goods, and we have tried to maintain the high standard in which they are held by steam users throughout the world. Copper, lead, Babbitt and all kinds of metal discs have been experimented with for the past twenty years, and in almost every instance, when under the action of steam, they become oxidized and hard, so that chip or scale getting between the disc and seat causes a leak, which necessitates regrinding. Insist on having the genuine Jenkins Discs; the difference in cost will not pay you to experiment. If you wish discs for any particular purpose, write to us; we can experiment cheaper for you than you can for yourselves. **Jenkins Discs will stand steam, oils or acids. We have special soft discs for cold water**

Jenkins Brothers' Pump Valves

Adapted to every pumping requirement, these valves are especially suited for pumping hot water, syrups, beer and other destructive fluids; also muddy and gritty water. When rubber valves have been found useless, these valves have given entire satisfaction.

For mining and high-pressure service, also for elevator pumps, Jenkins Brothers' No. 88 Pump Valves are in use under 450 pounds pressure, and are proving themselves equal to every requirement.

We also manufacture a fine grade of Soft Rubber Valves for cold water and air service.

When ordering valves, please state for what purpose you desire to use them.

Jenkins Brothers' Valves, Jenkins '96 Packing and Rubber Specialties received the Highest Awards at the Pan-American Exposition

All our different specialties are stamped with Trade-Mark

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